No 2661 VOLUME 77 FRIDAY 11 MARCH 1960

FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

Official Organ of the Royal Aero Club First Aeronautical Weekly in the World Founded 1909

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Iliffe & Sons Ltd, Dorset House, Stamford Street, London SE1; telephone Waterloo 3333. Telegrams Flightpres Sedist London. Annual subscriptions: Home £4 15s. Overseas £5. Canada and USA $15.00. Second Class Mail privileges authorized at New York, NY.

Branch Offices Coventry: 8-10 Corporation Street; telephone Coventry 25210. Birmingham: King Edward House, New Street, 2; telephone Midland 7191. Manchester: 260 Deansgate, 3; telephone Blackfriars 4412 or Deansgate 3595. Glasgow: 26B Renfield Street, C2; telephone Central 1265.

New York, NY: Thomas Skinner & Co (Publishers) Ltd, 111 Broadway 6; telephone Digby 9-1197.

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Bolt from the Blue . . .

IN the recent Estimates and Debates relating to defence and the armed services the mobility of ballistic missiles has been the principal, and most hotly contested, theme. On February 16 the White Paper *Report on Defence* remarked simply that the possibilities of mobile launchers, "whether aircraft or submarines," were being investigated. This comment precipitated an avalanche of conjecture and criticism in respect of the fixed-site Blue Streak. The Air Estimates, published two days later, added precisely nothing to the information given—indeed, they made no allusion to missile mobility whatever. "What seems to have been missed here," we commented in this column, "is the possibility of adapting the V-bombers for the launching of some such weapon as the American Skybolt."

The effect of this remark is difficult to determine; but there is no doubt that the air of the House suddenly seemed to be filled with Skybolts. Ministers, who had not previously acknowledged the new missile's existence, quickly began some quite ardent courting. Thus, the Minister of Defence on February 29: ". . . since I have held this office we have seen the emergence of what may be a new break-through in missile deployment. This is a delivery system called Skybolt—a ballistic missile of considerable range and great hitting power, which can be launched from an aircraft. It can be seen at once that a missile of this type is of great interest to us." Then, on March 3, the Secretary of State for Air: "We recognize that Thor will at some stage become too vulnerable to the enemy missile to be wholly credible as a valid deterrent, and that over the years the Blue Steel guided bomb will become less capable of penetrating the enemy defences. This process will be a very gradual one, but when it happens we must be ready to replace it with a weapon which is subject to neither of these weaknesses. For this reason, we are taking a close interest in the American missile Skybolt which, although now in the development stage, should be ready for service in about the right time-scale."

. . . or Predicted Evolution?

What emerges from the foregoing is (1) the manned aeroplane promises to continue as a complementary arm to the ballistic missile—and in a far closer relationship than was generally foreseen even a year or two ago; (2) the V-force of Bomber Command looks like going down in military history as a regular Old Guard, armed successively with weapons ranging, in equivalent fire power, from Brown Bess to Honest John—for such is the relationship between, say, a 500lb G.P. bomb and Skybolt; and (3) not only will the manned aeroplane survive; it may well appear in a new species.

This was recognized by the Air Minister in his recent statement when he said: "In the longer term, perhaps, when the V-bombers at last begin to wear out, their missiles could be taken over by a different type of aircraft—not a bomber in the historic sense, but a longer-endurance aircraft, capable of combining the rôle of missile-launching platform with, for example, that of the transport aircraft. This would preserve the continuity of our skill and experience, it would conserve our resources, and it would carry the concept of flexibility and versatility to its logical limit."

In these words there is exhibited not only a clear recognition of defence needs, but a vindication of the industry's unquenchable clamour for continuity in aeronautical research. There is, too, the prospect of a rationalized approach to the supersonic airliner, and the emergence of an aircraft that could be largely funded by the RAF and proved in military service before entering commercial operation with BOAC and before being made available for export. An aircraft, in brief, that could solve many pressing problems and save a vast amount of money.

FROM ALL QUARTERS

RAF Thor Completion

SIXTIETH and last of the Thors required to equip present RAF sites in Britain was leaving the Douglas plant at Santa Monica, Calif, last Tuesday morning in a Globemaster of the 40th Air Transport Squadron. Flying via Dover, Delaware, where a crew-change was scheduled, the aircraft was due in England—at Luffenham, Lakenheath or Driffield—on Thursday.

On board, by invitation of the USAF, was Kenneth Owen of *Flight*, who will describe this missile-delivery flight—typical of many made by MATS—in a forthcoming issue. (*In today's issue, pages 339-342: "Thor in Service."*

RAF Assistance at Agadir

AIRCRAFT of the Royal Air Force have been assisting relief work at Agadir by carrying in supplies and evacuating casualties from the earthquake-devastated town. Shackletons of No 224 Sqn, based at Gibraltar, have flown-in large quantities of blankets, medical supplies, rations and chemicals and the squadron has made a gift of 10,000 cigarettes to survivors. Its aircraft have also brought out survivors to Marseilles, Rabat, Casablanca and Gibraltar. A Beverley from RAF Dishforth took to Agadir five tons of plague-prevention chemicals from Mulhouse in eastern France.

Exports: A Good Start

JANUARY export figures were the largest ever recorded by the British aircraft industry during the first month of a year. The total, £13,310,502, was made up as follows: aircraft and parts, £6,616,002; aero engines, £6,084,977; electrical equipment, £299,443; aeronautical instruments, £247,296; and tyres, £62,784. Leading buyers of aircraft and parts were Switzerland (£1,712,155), Argentina (£1,101,327) and India (£565,329); and leading buyers of aero engines and parts—published by the Board of Trade for the first time—were the US (£1,266,995), France (£710,801) and India (£675,999).

Longest-Distance Exercise

BRITANNIAS of RAF Transport Command are being used for the first time on a large scale in a strategic airlift in Exercise "Starlight," the joint Army-RAF enterprise being undertaken in North Africa this month. The largest exercise of its kind ever held outside the UK, with about 4,000 troops and 130 vehicles being moved by air, this is also the first occasion on which No 38 Group of Transport Command has taken part in one of these mobility exercises.

AVM Peter Wykeham, the AOC, was at a press conference in the Ministry of Defence last Monday to describe the air aspects of Starlight, the strategic lift for which was due to begin yesterday (March 10). The build-up had begun last month when Whirlwinds, Pioneers and Twin Pioneers were flown out to North Africa and groundcrews, administrative staff, stores and equipment positioned. AVM Wykeham said that the fighting troops would be flown out in nine Britannias, 16 Hastings and 16 Beverleys, making respectively 29, 26 and nine sorties. Two Comets would also be engaged, on special duties.

The AOC explained that El Adem was to form the strategic base for the exercise, and Tmimi, 50 miles north-west, the airhead. The Beverleys would be flying into this desert strip, familiar to those who participated in the Western Desert campaigns of the last war. From the airhead the fighting troops would be supplied by the Twin Pioneers, Pioneers, Whirlwinds and Alouettes. Simulated fighter activity was being provided by aircraft from HMS *Albion*, and Fighter Command were sending out a small strike force of Hunters.

Maj-Gen R. G. S. Hobbs, who with AVM Wykeham is joint director of the exercise, explained that Starlight would have three phases—the airlift from the UK, the lift from El Adem to Tmimi and operations west of Tmimi (March 21-27). Lt-Gen Sir Nigel Poett, as commander of the Strategic Reserve, has overall responsibility for the exercise with the AOC-in-C Transport Command, Air Marshal Sir Denis Barnett.

***LOX BOX:** At the Normalair Works recently, James C. McDonald, UK representative of Republic Aviation, received the final batch of liquid-oxygen convertors to complete current contracts. These convertors are installed in the F-84 Thunderstreaks used by NATO air forces. In the picture Mr McDonald is taking over the last unit from Normalair foreman C. Millman*

France's Supersonic Bomber

THE Mirage IV two-seat supersonic bomber, built by Marcel Dassault and powered with two SNECMA Atar 9 turbojets, has completed its constructor's trials. On its 53rd flight it was ferried to the Flight Test Centre at Istres, on which occasion it sustained M1.9 for eighteen minutes. The pilot was René Bigand.

Cessna-Holste Co-operation

A MINORITY interest in the French aircraft firm Avions Max Holste is being acquired by the Cessna Aircraft Co. The latter's president, Dwane L. Wallace, said recently that final arrangements were not yet completed but all necessary approvals for the transaction had been given by the French Government.

More Atlantic Facts

THE latest announcement concerning the Bréguet Atlantic maritime reconnaissance and anti-submarine aircraft for NATO air forces quotes a cruising speed (presumably maximum cruise) of 600km/hr (373 m.p.h.). It is also stated that the submissions by 26 companies—representing eight countries—were narrowed down to proposals by Bréguet, Nord and Avro. Nord was eliminated and on December 31 last the Bréguet was chosen.

A "direction committee" has been planned which will represent the countries concerned in building the aircraft (France, Holland, Germany and Belgium). A technical consulting committee has also been set up, and this is open to all countries. Thus, Great Britain and Canada will be able to watch the development.

The 2N Crusader

ALTHOUGH Chance Vought's F8U-3 Crusader never came to fruition, the basic Crusader has been steadily improved. Finest of all the derivatives is the F8U-2N, which will be the first supersonic all-weather intercepter in US Navy service. The first 2N flew for 84min on February 16, three days ahead of schedule.

Although superficially similar to the F8U-2, the new version incorporates a new search and tracking radar of greater power; increased internal tankage (early Crusaders have flown for nearly 4hr without refuelling); a revised Vought autopilot; a Pratt and Whitney J57-P-20 engine of increased thrust; provision for firing "advanced missiles now under development" in addition to Sidewinder; "hard-harness" wiring, all looms being packaged in glass-fibre ducts; and revised instrumentation and interior and exterior lighting systems. Contracts for the 2N total $100m, and will keep production going through next year.

Canadair at Work

FEW Western manufacturers have three entirely different aircraft in the flight-test stage. One such firm is Canadair, and the following notes summarize present progress.

CL-44. Powered by four Rolls-Royce Tyne 512s, the Forty Four has flown 50hr in 30 flights since mid-November. Tests have included stalls, trim-control, manœuvring, stability, measured take-offs and initial systems checking. Training of RCAF CL-44 pilots has started.

Canadair 540. Powered by two Napier Eland 504s, the first production 540 has flown 30hr in 20 flights since January 7. The 40hr test programme (7hr normal plus 33hr special testing to military specifications) is near completion. Items included are take-offs at up to 57,500lb, autopilot behaviour, electrical loads and fuel dumping.

CL-41. Powered by a Pratt & Whitney JT12, this aircraft has flown 24hr in 26 flights since January 13. Completed tests include general handling and stalls, spins, and dives up to M0.7, sufficient to give a flight-envelope suitable for demonstration purposes.

***SURVEY VERSION** of the Piaggio P.166, newly delivered to Hansa Luftbild. Five P.166s are now registered in the UK, of which three are in use and the other two are to be collected in the spring. Patair, which bought the first P.166 in the Commonwealth, has now ordered a second. Another, ordered by a Swiss publishing firm at a basic price of £31,610, has detail modifications that include higher side-windows for the cockpit*

Saved for Posterity

AT the Science Museum, South Kensington, last Friday, James Martin (chairman and managing director of Martin-Baker Aircraft) presented two ejection seats—the first to be used in a live test in this country, and the first used in an actual emergency—to the National Aeronautical Collection. He also presented the cockpit of the Gloster Meteor used in the first test, given to the museum by his company in collaboration with the Ministry of Aviation.

The new exhibits were accepted by W. T. O'Dea, Keeper of the Department of Aeronautics; and also present at the ceremony were "Bennie" Lynch, who made the first live ejection test, and J. O. Lancaster—first of the 300-odd successful users of Martin-Baker seats in emergency conditions.

***CHIEF TEST PILOT** of Flight Refuelling Ltd: P. R. Hornidge, recently appointed to succeed T. Marks, who has relinquished the position to join the company's commercial department. Mr Hornidge joined Flight Refuelling in October 1948; previously he had been with the Bristol Aircraft Co for seven years as a test pilot*

IN BRIEF

Formation of the British Aircraft Corporation was announced last week, as a holding company for English Electric, Bristol and Vickers aviation interests. With a capital of £100 in £1 shares, its objects are "to design, manufacture, import, export and deal in aeroplanes, airships, seaplanes, aircraft, guided missiles, rockets, etc."

A Lightning from RAF Coltishall was lost last week when the pilot ejected, landing unhurt near Sculthorpe. The aircraft had been headed out to sea before being abandoned.

Search operations for the Lightning T.4 from which English Electric test pilot John Squier ejected over the Irish Sea last October have been abandoned.

Six members of the West German Bundestag have just completed a 12-day visit to British aeronautical establishments. Their tour included a BLEU demonstration at RAE Bedford.

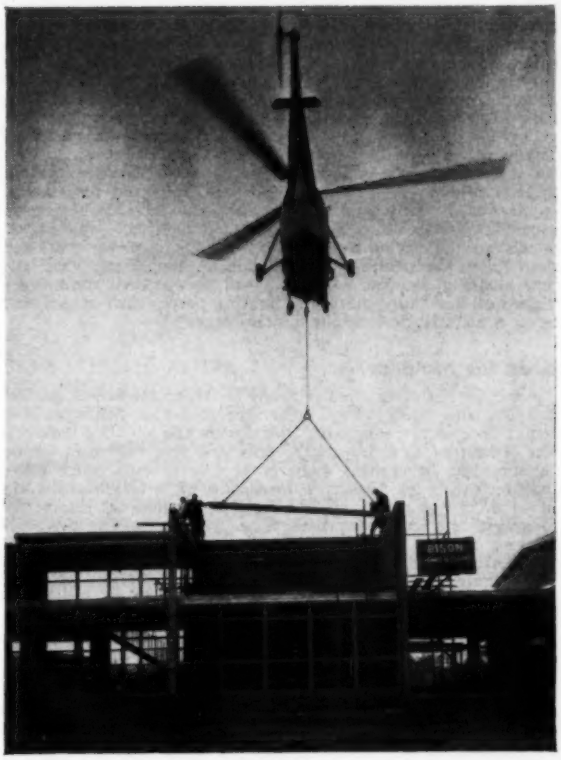
Oskar Asboth, the helicopter pioneer, died in Budapest recently at the age of 69 after a long illness. His work on helicopters was not fully appreciated in Hungary and in the late 1920s he went abroad to continue his research. In 1955 he received an international award for his work.

Hawker Hunter FGA.9s became operational in the Arabian Peninsula from last Monday, with the re-equipment of No 8 Sqn, which has for many years been based at Aden and up to now has been operating with Venoms.

Today Gustavus Green celebrates the completion of his 95th year. In January last year Mr Green was granted honorary companionship of the RAeS in recognition of his unique contribution to the powering of early aircraft by engines of his design and manufacture. Among these were the Short No 2 (in 1909) and the Blackburn Monoplane, the Avro Triplane, Cody Biplane and Handley Page Monoplane of 1910 and the Beta and Gamma airships.

Models of current aircraft made by British manufacturers were presented to the Empire Test Pilots School on February 26 and are being displayed in the entrance-hall of the ground school. The presentation, organized by "Bill" Bedford of Hawker, was made by H. G. Hazleden of Handley Page; and the models were received by the Commandant, Capt Ken Hickson. A total of 27 is to be supplemented by a further ten, and in addition to the Bristol Siddeley Orpheus, models of Rolls-Royce and D.H. engines are being included.

Roy Knabenshue, at one time manager for the Wright brothers and the first American to fly a powered airborne craft, died at Los Angeles last Sunday at the age of 83. He always maintained that he gained his distinction by accident, the feat being accomplished in a crude dirigible at the St Louis exhibition of 1901. According to his account, the motor was missing so badly that he called out "Turn it off!" but this cry was mistaken for "Let her go!" and he drifted across St Louis and the Mississippi River before landing.



***ON THE BEAM:** Recently a Westland Whirlwind was used as a crane to position concrete purlins, each weighing 15cwt, during the building of a school near Yeovil (see "Helicopters in the Building Trade," page 334). Last week, at Yeovil, the results of the experiment were the subject of a debate, the principal speakers being an architect and executives of the various contractors concerned. In the chair was Westland's assistant chief designer, John Speechley*

J. A. Hamilton of the RAE Farnborough is to lecture on *Aircraft of the Future* at the Aircraft Recognition Society's next meeting, which is being held in the library of the Royal Aeronautical Society, 4 Hamilton Place, London W1, at 7 p.m. on March 16.

Next Thursday's (March 17) issue of our associate journal *The Motor Cycle* will be a Spring Number and Buyers' Guide. It will contain the first of a special series of articles by champion John Surtees on racing methods.

We regret to record the death (on February 24) of Charles Cooper, who served on the editorial staff of *Engineering* for 60 years, from 1897 to 1957, except for three years in the First World War, when he was in charge of one of the early wind tunnels. He was joint editor at the time of his retirement.

Hunting Surveys Ltd are undertaking the aerial geophysical survey announced recently by the Ghana Government as part of their second development plan. The areas being investigated include most of the gold and manganese mines in Ghana and are known to be important mineral zones.

What is described as "the world's first airborne gravity gradiometer" is to be demonstrated in European countries after having made its début recently in Canada. It was demonstrated there by Dr Hans Lundberg, the geophysicist, at the first international symposium of arctic geology at Calgary. The gradiometer is basically a sensitive electric balance composed of two substantially similar masses suspended on thin filaments one above the other.

Point-scoring at Westminster

LAST WEEK'S DEFENCE DEBATE AS SEEN BY - - - - - - - - FRANK BESWICK

ONE cold morning in the empty sunless Westminster Hall I asked Lord Alexander of Hillsborough, then plain A.V., who had taken over the re-created Ministry of Defence, how things were going. I was never certain whether it was the prevailing temperature or the impending problems which caused him to answer quite so despondently, "Too many imponderables."

There have been many Ministers of Defence since Alexander took on the job—nine in the last nine years; but none, surely, if complete honesty prevails, can suppress all sympathy for his predecessor. Mr Watkinson, the latest in the line of Defence Ministers, announced in the Commons debate last week that "the Government are now engaged on a detailed review of our defence effort." These are familiar words. And a wise Minister, even after the review is completed, will not be too dogmatic about defence policy, for the technical facts of life with which he is concerned change as the pages are torn from the calendar.

Curiously enough, among all the changes the one constant thread of policy has remained the most neglected in practical application. Apart from the sort of platitude which Mr Watkinson used—"our main objective is to keep the peace"—the phrase which has most often occurred through the post-war years has been "need for mobility." Mr Watkinson himself said that "the new model all-Regular Forces . . . will have at their command a degree of transport ability and striking power such as we have never achieved before in our military history."

Need for Mobility

Amid all the controversies about conventional versus nuclear weapons, and regular versus conscript forces, most Ministers have found time to say something like this on the need for mobility. Yet Transport Command have only just received their second squadron of Britannias; there is as yet no firm order for a machine fitting the Minister's description of "a very heavy workhorse aircraft to carry big loads;" and the chances are that before long, with the retirement of the Comet 2, the Command will be without any jet aircraft at all. True, the Minister said that the RAF now had "under discussion" a transport jet aircraft which "might be based on the Comet or on the VC10, or possibly both." If an order is placed soon, and especially if the design is in harmony with the needs of the civil market, much might be forgiven. Nevertheless it is fair to remark again how curious it is that in the field of transport aircraft, where there was least doubt both about needs and technical possibilities, expenditure has been most restrained. And as Mr Watkinson saw fit to call attention to the value of "Transport Command and the civil aircraft industry working together," one might even spare a thought for the episode of the V1000 and the VC7.

The Minister also stated that for the medium transport AW.660, for which there are now 20 on order with deliveries expected in 1961-62, there would soon be a follow-on order [for another 20, it later emerged—Ed]. As for helicopters, the Minister said that these "include the Whirlwind, the Wessex to come, and now the Rotodyne, a revolutionary aircraft with great civil and military possibilities."

It was the redoubtable Col Wigg who most effectively dashed a little cold water on the Minister's complacency. "Sales talk," he called the Defence White Paper. Of anti-tank guided weapons he quoted from *Flight* of September 5, 1958: "Fairey Aviation have been permitted to state that they are the contractors for the anti-tank guided weapons for the British Army first announced in the Commons in May 1957." That weapon, declared Col Wigg, was still not with us and we should hear no more about it. Of the stand-off bomb he quoted Paragraph 10 of the Air Estimates for 1956: "The Mark 2 Vulcans and Victors will be capable of carrying both free-falling and stand-off nuclear weapons." The statement, he declared, was an admirable one—but we still had neither the weapons nor the machines for launching them.

Critical Analysis

From the Government back benches the most informed and reasonable critical analysis of defence policy came from Nigel Birch, a former Air Minister. After a sweeping denunciation of the Opposition and all their works Mr Birch went on to look at what was being done by the Government which he so recently left. He was certain about one thing: the defence policy was bursting at the seams. "There are more plans and projects afoot than possibly can be carried through within any reasonable defence ceiling. In the White Paper, apart from anything else, there are projects for 11 different types of missile and 12 different types of aeroplane . . . it will be impossible to have significant guarantees of any of the weapons. We therefore run the risk not only of wasting money and scarce skills but, at the end of the day, of being weak everywhere and effective nowhere."

Mr. Birch went on to argue that if we are to be more selective about the choice of weapons then, for Britain, nuclear arms are out. In the first place, in our confined island (he claimed) it was nonsense to talk of using the Great Deterrent independently. Secondly, he thought that conventional arms had a continuing part to play. After all, they had settled many things since the war. As he forcefully put it, "Conventional arms ended French influence in South East Asia. Conventional arms have kept Malaya free. Conventional arms have kept Hungary slave." Nevertheless he was not for leaving the nuclear club; our membership would be part of an alliance. And if we were to equip ourselves on that basis, then Blue Streak should be cancelled forthwith.

Blue Streak, in fact, was poorly supported in the debate. Even the Minister was restrained about its prospects; work upon it had taught us much about the technique of propulsion and the complications of guidance and computer systems, but no promising operational future was depicted for it in its underground silos. The Minister brightened perceptibly when he went on to talk of the possibilities of Polaris and the emergence of Skybolt. This latter ballistic missile, said Mr Watkinson, would undoubtedly be eminently suitable for our V-bomber force and would extend its life very considerably.

Not unnaturally. the official Opposition had much criticism to make of the credibility of the British nuclear deterrent. Mr Strachey spoke of large, clumsy, unprotected, slow-firing Thor rockets, sprawled over our countryside, trained on Russian cities but also right under the enemy's guns. Blue Streak's story, he said, was a sad one; that rocket was unlikely ever to go into production. Of the claim by the Secretary of State for Air that the projected early warning system would "preclude surprise attacks by missiles" he said that a "more outrageously untrue statement" had never appeared in a Service memorandum.

Mr Strachey contended that Bomber Command as a credible deterrent was better than Thor but that we should consider very carefully the possibility of the world-wide dispersal of bomber bases with improved means of protecting them.

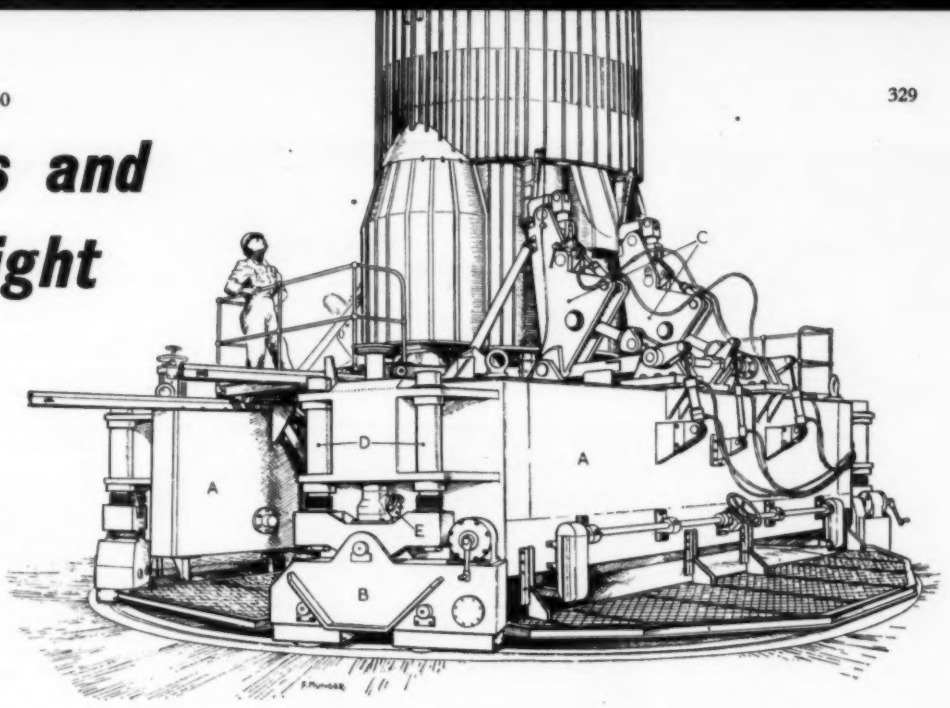
General Cowley's Words

From the Government benches Sir Fitzroy Maclean made it clear that, with other Conservative ex-Ministers, he was a member of the Cowley Club; and he claimed the Secretary of State for War, also, as a supporter for the case summed up by General Cowley in the words, "the British contribution to the peace of the world can be far more useful in other directions than in producing weapons which can only be useful because of their threat and which can only be threatened in very exceptional circumstances." Sir Fitzroy also put the case for mobility in General Cowley's words: "we should do better to rely on rapid arrival than on heavy armament."

Cdr Maitland brought up the heaviest guns in support of his own Ministers. Whilst we still pinned our faith on the deterrent it was a great pity to play it down. He thought the V-bomber force today was probably the most effective vehicle in the world for carrying megaton bombs. He believed that we had sufficient of these weapons to paralyse or destroy an enemy without any assistance from any other nation. Nevertheless he did not think we had yet achieved a genuine nuclear stalemate, and we should press on until we had reached that position. We could not claim to have reached that position until it was possible to say that even if one side were completely wiped out there would still be inevitable destruction for the other.

The official Opposition amendment, "whilst recognizing the need for an adequate policy for collective defence and security," went on to censure the Government for its vacillations and confusion. It was not difficult in the course of political cut-and-thrust to point to the obvious confusions among Opposition spokesmen. Inevitably Mr Shinwell's known lack of affection for his present leader (and former Parliamentary Secretary at the Ministry of Fuel and Power) attracted wide public attention and provided opportunity for easy debating points. But beneath all the political candyfloss this defence debate did much to make some of the problems clear. If the solutions were not unanimously agreed then that only emphasizes that A. V. Alexander had greater justification than he realized when he complained of the imponderables. If I were to be dogmatic about any one point brought up in this two-day debate it would be that it is time that talk of mobility was translated into something a good deal more tangible—a few squadrons of transport aircraft, for instance.

Missiles and Spaceflight



Our artist Frank Munger prepared this drawing of the Blue Streak launcher for one of our associate journals. Fabricated by Morfax Ltd., the principal units comprise: A, main box beams; B, bogie unit; C, release gear (both sides of missile); D, vertical guide rods; E, lifting-jack handle socket

BLUE STREAK LAUNCHER

The drawing reproduced on this page was prepared for our associate journal *Welding and Metal Fabrication*. In this publication's March issue* appears an 11-page article on the manufacture of the launcher for Blue Streak. Few of our readers need to be told that this missile is Britain's LRBM, or that its development is being managed by de Havilland Propellers, with major sub-contracts let to de Havilland Aircraft, Rolls-Royce and Sperry. Nothing, however, has previously been published on the launcher. This unit can be accurately rotated in azimuth, and it may be a requirement for the inertial guidance system to start off on the correct bearing. This is also the case with the US Army Redstone and Jupiter, but none of the USAF strategic missiles have to be rotated before launch. The launcher also appears to make no provision for weighing, thrust-measuring, an umbilical mast or propellant-loading systems. In fact, it may be that the launcher described here is an interim development model.

As our drawing shows, the body of the launcher is built up from a pair of box beams A, each some 26ft × 5ft × 7ft high. All-welded in 1in Conlo 1 notch-ductile steel, these beams are connected by pin-jointed cross-braces from 3in plate, and are fabricated to very close tolerance, largely by optical methods. At each end of each beam is a bogie unit B, set at 32.5°. These bogie units employ 20in cast-iron wheels manually driven through a reduction ratio of 357:1 in order that the complete launcher and missile may be rotated in azimuth about a circular track. On top of the launcher are four release-gear arms C, which hold the missile securely in all wind conditions during the fuelling and pre-launch countdown. The four arms are pulled away to release the missile by an electro-hydraulic system which ensures that release occurs at all four points at the same instant.

Each bogie unit is attached to the launcher beams via a yoke bracket and a pair of 6in-diameter vertical guide rods D and central lifting jack. The latter, manually operated by inserting a lever into the socket E, can lift the complete launcher platform clear of the ground. Once lifted it may be rotated in azimuth to the desired angular position. The jacks are then again lowered until the launcher is resting on the ground, jacking continuing until the bogie wheels are all clear of the track.

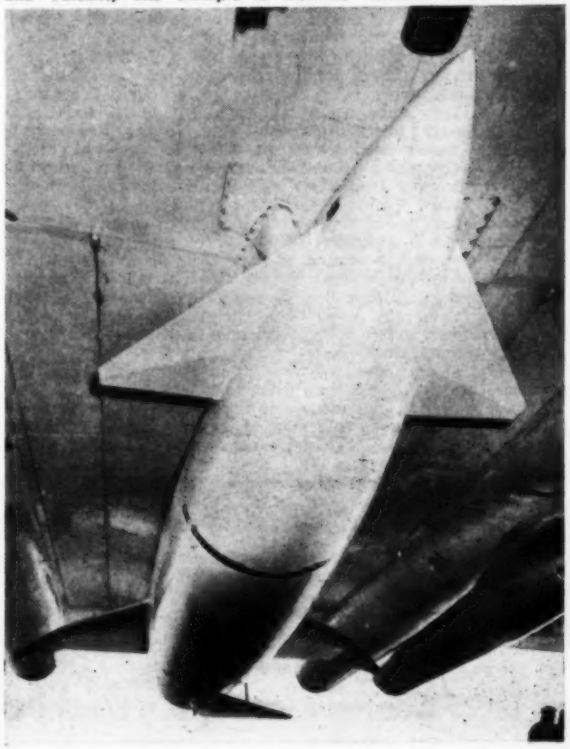
Design and construction of the launcher has been entrusted to Morfax Ltd, of Mitcham, Surrey. It is unfortunate that security prevents publication of the actual method to be employed in an operational emplacement. From the outset Blue Streak has been designed for hard (underground) deployment, yet it is most unlikely that the missile is intended to be launched from the bottom of its silo. It seems most likely that the procedure will be for fuelling and as much of the pre-launch work as possible to be completed within the silo and for the fuelled missile and launcher then to be raised to ground level shortly before completion of the countdown. Launch weight of a Blue Streak is unlikely to be less than 75 tons, and the launcher itself weighs 70 tons, so the problems involved will be appreciable.

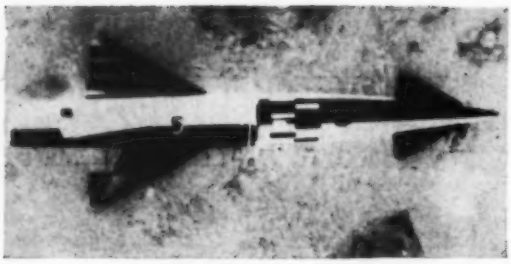
**Available from Dorset House, London SE1, at a price of 3s, and also including a feature on the manufacture of the North American B-70 Valkyrie.*

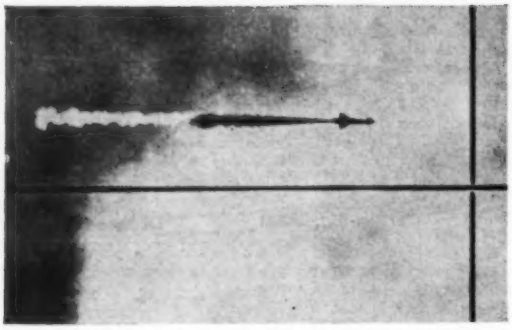
BLUE STEEL IN ACTION

During 1956 the Weapons Research Division of A. V. Roe & Co Ltd were entrusted with the entire development of a major weapon system under the code name of Blue Steel. Although generally known in Britain as a "stand-off bomb," Blue Steel is a miniature supersonic aeroplane capable of being launched at high altitude and high subsonic speed from a V-bomber and thereafter transporting a megaton-yield warhead several hundred miles to a pre-selected target. As we described in our September 11 issue, the missile has self-contained inertial guidance by Elliott Bros (London) Ltd, which during captive flight is monitored by other airborne equipment and assists in the navigation of the parent aircraft (a Vulcan B.2 or Victor B.2). Upon release final position-

Full-scale Blue Steel test vehicles have been launched from Valiants and Vulcans; this example is mounted beneath a Vulcan B.1







As noted in the accompanying text, Blue Steel test vehicles are now engaged in flight trials at the WRE range at Woomera. This sequence, taken from a Valiant, shows release of the missile, the free drop and (looking vertically downwards) the light-up of the Double Spectre rocket engine. The weapon will then fly on ahead and climb

Missiles and Spaceflight . . .

information is fed in from the aircraft. During free flight the Blue Steel is self-contained, and can be programmed to follow any flight-profile from about 100,000ft down to sea level at a cruising speed of about M1.6.

A description of the weapon was contained in our Missiles review number last November 6. Aerodynamically it is a canard, the aerodynamic surfaces consisting of a rear-mounted delta wing with ailerons, a dorsal rudder, a ventral fin, and delta foreplanes to provide control in the pitching plane. The foreplanes are cropped at the Mach angle, and the wings have squared-off tips which droop downwards in order to clear the engine tailpipes when the missile is installed beneath the Victor. The ventral fin is arranged to fold horizontally (as shown in the photograph on the previous page) owing to the Victor's small ground-clearance.

Basic design, supplemented by a vast amount of system development, rig-testing and engineering refinement, were all conducted at the Division's facilities on the company airfield at Woodford, Cheshire. Flight trials began with two-fifths scale models (of the type displayed at the SBAC exhibition in 1958). Powered by twin liquid rocket motors, these models were employed chiefly in the development of the missile's aerodynamics and autopilot. Most were dropped from early Valiants and Vulcans down the Aberporth range. Owing to the confines of Cardigan Bay many hardly achieved cruising flight at all. In many cases the sole object of the trial was to investigate separation from the parent aircraft and the subsequent behaviour of the missile up to the point of light-up. Eventually full-scale test vehicles were employed for the same purposes, until a clean break could be guaranteed. Initially the missile falls free; it is well below the bomber when the engine fires (see picture) and thereafter accelerates ahead before beginning its climb to the stratosphere.

For over a year, advanced testing designed to explore all the airborne sub-systems has been in hand at Woomera. Here there are no geographical limitations, and the inertial navigator can be given its head over the full range of the missile. All these test vehicles have been powered by Double Spectre twin-barrel rocket engines by D. H. Engines. It is clear, however, that a different powerplant will be employed in the production missile. One could conjecture that a derivative of the Bristol Siddeley Gamma might be chosen, but no official statement to this effect has yet been made.

For many months a Services Trials Unit from RAF Bomber Command has been active at Woodford, operating several V-bombers to assist in the development of the weapon. We are not permitted to state whether this unit has now moved to Woomera, but it is bound to do so in the course of time. Little was said of Blue Steel in the recent *Report on Defence*, but in the Press conference following that document's publication it was revealed that the missile will go into service "in the near future." When it does it will greatly increase the lethality of the latest Vulcans and Victors, and should prolong their active life by a number of years.

MOON EXPLORATION SYMPOSIUM

At a symposium held by the British Interplanetary Society at Caxton Hall, London, last Saturday a team of three speakers described various aspects of the forthcoming exploration of the Moon.

Patrick Moore set the scene, saying that apart from two widely separated incidents, there was no worthwhile evidence of any changes taking place on the Moon. For the purpose of exploration it was dead and lifeless. Of most importance, perhaps, was the revelation that the latest radio-telescope measurements of the tenuous atmosphere surrounding the Moon indicated that it was considerably less dense than had been thought: probably the density was only 1/100,000 that of the sea-level atmosphere on the Earth. It was too thin to afford protection against meteorites, nor would it provide an ionosphere to permit radio communication beyond the satellite's horizon.

In the second paper Kenneth Gatland, vice-chairman of the Society, covered the exploration by un-manned instrumented probes. The next step up the astronautical ladder would be the soft landing of a probe on the Moon's surface. In function the probe would be similar to the remarkable Grasshopper weather devices which the United States parachuted into inaccessible areas. In these the impact of landing triggered an explosive charge to detach the parachute. A second explosive charge then released six spring-loaded legs which automatically righted the device. A third charge extended a 20-foot transmitting aerial. The Grasshopper then automatically transmitted weather data at predetermined intervals. Mr Gatland discussed various probes ranging from a simple spiked canister and solid-propellant retrorocket to a sophisticated Russian design-study for a tanker intended to traverse the surface of the Moon, scanning the scenery with a television camera and obtaining soil samples from a retractable ventral probe.

Of particular interest was the speaker's own brainchild, MIGRANT—a design-study for a Moon Instrumented Guided Receiving and Notifying Transmitter. Proposed in 1958, it incorporated many features now being considered by NASA in their probe studies.

The symposium was concluded by W. N. Neat, of the de Havilland Engine Co, who surveyed the ultimate manned exploration of our satellite. This, he explained, raised a major problem: once you put a man on the Moon you are faced with the task of getting him back. Mr Neat illustrated the fundamental difference between the return journey and the one-way trip involved in soft-landing a probe. Even assuming advanced constructional techniques and the use of the best chemical fuels available, it seemed unlikely that the journey could be made with a take-off from and return to the surface of the Earth. Orbital refuelling seemed to provide the answer here.

The French air ministry announced on March 5 that a Véronique sounding vehicle, launched recently from Colomb-Bechar, reached a height of almost 200km (124 miles).

At Atlas ICBM exploded on its pad while being fuelled at Vandenberg AFB, Cal, on March 5. No injuries were caused and it seems doubtful that a warhead was installed. The last 17 Atlases to be launched have all flown successful missions.

The first Saturn booster is now being assembled on the rebuilt and strengthened static-test tower at Redstone Arsenal preparatory to firing tests. The tankage sections, 80ft long and 22ft in diameter, were hoisted into place on March 2.

Congressman Charles Porter, of Oregon, asserts that, when he visited RAF Feltwell (see pages 339-342) last June, an RAF officer produced both keys needed to unlock the control mechanisms and enable a countdown to proceed. He claims that the Defence Department censored his story at that time, and rejects all explanations so far offered to him.

Missiles and Spaceflight . . .

LOOKING AFTER THE PENCE

IN the 1958-9 *Civil Appropriation Accounts* (Classes VI-X), now on sale (HMSO, 16s), miscalculations in the estimated costs of guided weapons figure prominently for the first time. The report deals with the year ended March 31, 1959, and describes the financial history of three missiles. These are identified only as "Type A, B and C" but little skill is required in identifying the weapons concerned (in fact, all three have been named by the daily Press). The following are extracts from the report.

Type A "In November 1948 the MoS sought Treasury approval for . . . a particular type of guided weapon for which a Staff Requirement had been issued. The Ministry stated that the total cost of development might be of the order of £1-1.5m. The Ministry informed the Treasury that they were proposing to place the work with a member company of a large Group, and they had been assured that the full resources of this Group would be behind the company. . . . The Treasury approved the proposals in December 1948, and in February 1949 a contract was placed covering development up to March 1950. Development thereafter continued under annual contracts up to March 1953, when a contract was placed covering development to completion. A specification was not incorporated; instead the contractor was provided with details of the Staff Requirement setting out the objectives to be aimed at. . . .

"At a meeting . . . in February 1953 it was stated that a great deal of time had been lost . . . in July and August 1954 the Ministry made representations to the contractor about further delays. In October 1955 in discussion with the management of the contractor's parent Group, the Ministry were critical of the Group's failure to bring its resources into action. . . . In August 1956 . . . the Ministry's Director of Contracts negotiated a reduction of £36,125 in the profit allowed. The Ministry themselves thereafter assumed responsibility for co-ordinating all firms. . . . Delivery is planned to commence at a date some five years later than that originally called for . . . [but] in good time to meet the dates when the Service Department now requires them.

"In reply . . . the Ministry stated that it was the first guided-weapon project in this country and was the start of the process of building up a guided-weapon technology. Before 1948 work on guided weapons had been limited to research at Ministry Establishments and the manufacture of simple test vehicles by industry. Two particular sources of delay were the need to change from one type of rocket motor to another, and the failure of the main contractor to provide the degree of leadership expected and to apply the requisite amount of effort to pursue a balanced and vigorous programme.

"The Ministry stated in this connection that the profit penalty was not an assessed compensation for extra costs which had been incurred through delays for which the contractor was responsible. General dissatisfaction with a contractor's work on such a development project was in the main a matter of opinion and impossible to express in monetary terms which could be relied upon for forming a claim against the contractor; but the Ministry had insisted on a reduction in profit as an expression of their dissatisfaction. . . .

"The latest estimate of the direct cost of developing the missile and its control and guidance systems is £40m. The Ministry explained that the impossibility of estimating the time and effort involved in completing the programme meant that the cost estimates made at the start of the development could only be conjectural. In accordance with the practice at the time, the initial estimate of £1-1.5m represented estimated payments to the main contractor only; and available records seemed to indicate that it related to the development period only up to the time when intensive firing trials would start, although this was not made clear to the Treasury. However, the Ministry had taken the initiative in providing the Treasury with estimates which took account of all the incidental costs of development, and this was now the standard practice for guided weapon projects. Actual expenditure under the main contract up to the start of intensive firing trials was £9m, and this, allowing for increases in wages and materials prices, gave a figure of £6m to compare with the initial estimate."

Type B "In August 1950 the Ministry . . . placed a contract for development of another type of guided weapon, based on a design study carried out by the contractor proposed for the development contract. It was tentatively estimated that the total cost of the project would be of the order of £2.5m. The contract covered work up to March 1951 and thereafter development continued under annual contracts until March 1953, when a contract covered development to completion.

"The weapon was initially designed to meet a War Office requirement, but was later developed for the Air Ministry in accordance with an Air Staff Operational Requirement. After a review on economy grounds in 1955, work was continued with a view to only limited production of the weapon for the Army, pending development of a more advanced version in which both the Army and RAF were interested, and for which a development contract was placed in March 1956. It was accepted that the original weapon would not meet the full Operational Requirement.

"During the financial year 1956-57 the contractor was anxious to maintain his total effort on both the original weapon and its more advanced version at a rate greater than the Ministry were prepared to finance. The contractor accordingly offered to finance from his own resources work to a value of £0.75m that year, provided that a production order for the Army, which was then being considered, was placed by December 31, 1956. Under the terms of this offer, which was implemented after a formal exchange of letters in September 1956, it was agreed that the £0.75m borne by the contractor would be recoverable by additional payments at an agreed rate on production orders for either the original weapon or its more advanced version. If production orders were reduced or cancelled the sums which would have been recovered on them would rank as cancellation charges against the Ministry.

"In December 1956 the first production order for the original weapon was placed, covering missiles for Army use, and in November 1957 a further order was placed covering missiles for use in trials by the RAF. The latter order was reduced in July 1958 and cancelled completely in September 1958. Shortly afterwards the Air Ministry abandoned their interest in the advanced version . . . in favour of an advanced version of a different weapon. . . . The contractor claimed immediate reimbursement of his development contribution at the agreed rate in respect of all missiles cancelled. A payment of £210,000 on this account was made to the contractor in January 1959. . . .

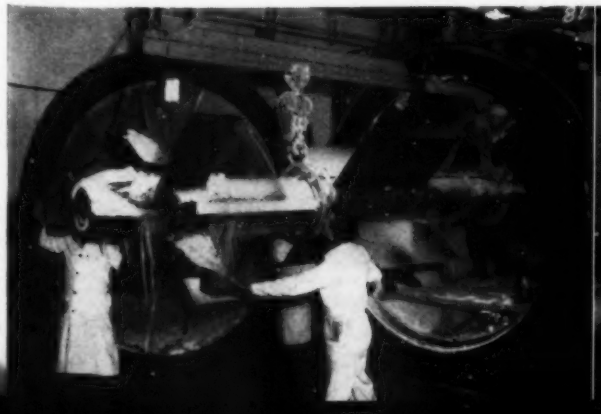
"Latest estimated development cost of the original weapon is £27m. The Ministry have informed me that the estimate of £2.5m made no provision for the cost of manufacture and evaluation of missiles for acceptance trials. No firm prices for production missiles have yet been agreed but the Ministry's estimated price at November 1958 was more than double the estimate . . . in September 1956. . . ."

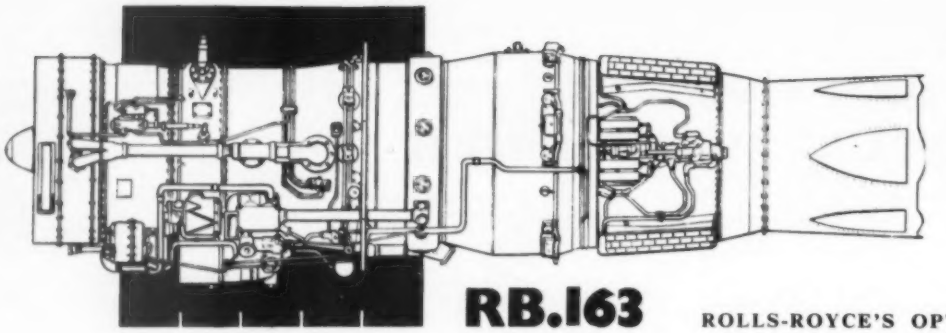
Type C "In 1952 the MoS obtained Treasury approval to place a contract for. . . a guided weapon with a contractor who had previously been carrying out a design study. Total cost was estimated to be of the order of £4m, spread over a period of approximately five years. . . . The original contract covered work up to March 1953 and a further contract covered development to completion. These contracts stated that development should be to a specification and in accordance with a programme approved by the Ministry. A specification was not, however, incorporated.

"In the course of developing the weapon it was found possible to build improved performance into successive models. . . . Some five months later the Ministry . . . stated that the Mk IV weapon represented so substantial a change that it was appropriate to . . . make it the subject of a separate development contract. . . . Subsequently the Treasury authorized progressive increases in the rate of expenditure, and ultimately gave their approval in principle for the Mk IV at an estimated total cost of £20m (additional to a revised total estimate of £23m for the Mk I). A separate contract for the Mk IV was not entered into until some fifteen months after the commencement of the work. . . ."

To an observer it seems clear that the root cause of the trouble in this case was the incredible over-optimism of those whose task it was to cost the programmes in the first place. The British aircraft industry seems to be peculiarly prone to over-estimating what it can do in a given period and to underestimating what it will cost. In conclusion, it is worth noting that, although the Ministry of Aviation (or, earlier, the Ministry of Supply) have never permitted any publication to reveal dates when contracts were placed, a chronological history of three weapons can be built up from the foregoing report.

In the development of most guided weapons, environmental and rig testing plays an even larger part even more than flight trials. Here are (from left) a frozen Seaslug; a frozen Thunderbird; and a Firestreak on a rig designed to prove the feasibility of tip launching





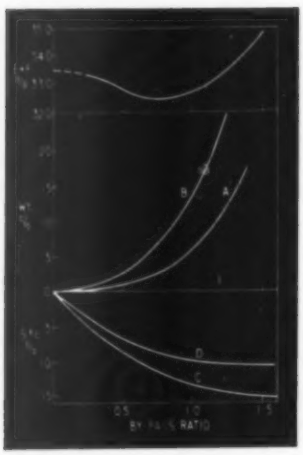
In this "Flight" copyright drawing the black panel represents a width of 5ft. To suit the Airco D.H.121 the reverser outlets lie above and below, but final standard of build has yet to be decided

RB.163

ROLLS-ROYCE'S OPTIMUM AIRLINE ENGINE

THIS journal has several times taken pleasure in emphasizing that Rolls-Royce Ltd have for some time been uniquely capable of designing a truly "optimized" airline powerplant. Today it can be assumed that such an engine will be a gas turbine of by-pass configuration; but plenty of variables remain to be resolved. The most important of these are the by-pass ratio, the overall pressure ratio, the work-split between the two spools, and the top temperature. These determine how an engine will perform on the bench; but an airline is interested in installed performance and operating economics, and so one must also take into account installed weight and drag, and the overall costs which the engine is likely to incur in service.

On this page we are able to reveal the basic characteristics of the RB.163, and in so doing give a clue to the design of the outstanding new family of high-subsonic transport engines being developed by the great Derby firm. As is well known, the by-pass formula really evolved with the Conway (described in our January 15 issue), but this engine has roots ten years long and is only now reaching its ideal configuration. When de Havilland began the design of the D.H.121 for BEA, Rolls-Royce planned a completely new engine for it, designated RB.141. As the 121 evolved it became obvious that it was too big for BEA's requirements, and shrinking the airframe made Rolls-Royce shrink the 141 engine. The 163 is the result. Owing to its later concept it is not quite an exact scale, but has a higher by-pass ratio. By-pass ratio of the RB.141 is 0.7, and three of these engines are now running on the bench.



Curves, plotted against by-pass ratio, of engine + fuel weight for 1,000 n.m. stage (expressed as percentage of aircraft gross weight), increase in total engine drag (A), increase in total pod drag (B), and reduction in s.f.c. allowing for (C) accessories and air bleed and (D) for increasing pod drag also

The curves plotted above show the results of generalized studies of the factors which influence an engine designer's choice of by-pass ratio. Generalized studies inevitably have shortcomings; when carried across to an actual engine it invariably happens that the points do not fall on the generalized curves at all. Nevertheless, optimization curves do indicate the sort of by-pass ratio necessary, and for short ranges the bracket is 0.6 to 1.0.

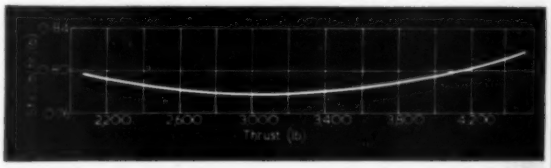
As the data show, Rolls-Royce have started off the 163 at the upper limit of this optimum range. There are several reasons for this. At a by-pass ratio of unity it can confidently be asserted that any silencing needed will entail virtually no penalty in weight or performance. Another reason stems from the fact that airframe manufacturers always demand increasing power from any engine. By starting off with by-pass ratio on the high side, the engine designer is given a lot of rope for future development, in that future transfer of some of the airflow from the by-pass to the high-pressure line can give increased thrust without penalty in specific consumption.

In next week's issue this journal will present its annual review of the world's aero engines. The sections dealing with Rolls-Royce, Bristol Siddeley, Pratt & Whitney and General Electric will indicate a significant trend: the world's engine designers are gradually converging on by-pass ratios of around unity. Rolls-Royce have approached this figure from below, whereas the American companies started at around 1.5 and Pratt & Whitney are on their way down. Bristol Siddeley started off even higher, and GE are probably waiting to see how their first family of engines behave in service before producing a new one. Whoever is right, these engines are fighting each other tooth and nail for the rewards of driving the superb high-subsonic vehicles which are going to carry the bulk of the world's air traffic during the next decade.

To an industry beset by cutbacks, rationalizations, take-over bids and indifferent morale, it is comforting to note that the Rolls-Royce engines appear to have a tangible start over all foreign competition. Into the 163 has gone wide experience with high-pressure engines, the world's greatest fund of knowledge of the service operation of air-cooled turbine blading, the fruits of extensive research programmes into by-pass ducts, reversers, silencers and installations generally, and—by no means least—well over 10,000,000 hours of gas-turbine operation in passenger service. The importance of this experience cannot be overestimated. Each "occurrence" has been faithfully picked up by the service department and deposited on the drawing boards of the men who have evolved the RB.163; and the resulting detail engineering is a prerequisite to an engine which really makes economic sense to an operator.

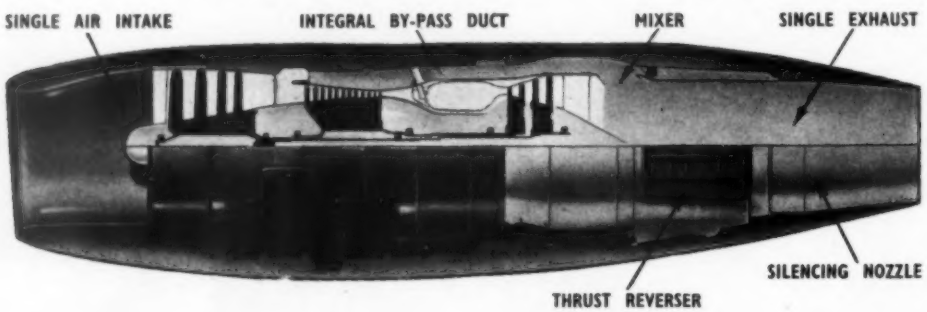
W. T. G.

Specific fuel consumption curve at 25,000ft, 525kt, ISA



RB.163 DATA

In configuration the RB.163 may be described as a by-pass turbojet, turbofan or ducted-fan engine, Rolls-Royce preferring simply "by-pass engine." From front to rear the main components comprise: a four-stage low-pressure compressor; a twelve-stage high-pressure compressor; a conventional can-annular combustion system; a two-stage high-pressure turbine; a two-stage low-pressure turbine; a hot/cold mixing unit; a reverser; and the silencer. Overall diameter, 34.8in; length, 110.05in; dry weight, 2,315lb; by-pass ratio, 1.0; mass flow, 202lb/sec; pressure ratio, 16 : 1; maximum take-off thrust (5min guaranteed minimum), 9,850lb with max s.f.c. of 0.578; maximum continuous rating (unrestricted guaranteed minimum), 9,450lb with max s.f.c. of 0.570.



This schematic section of the RB.163 illustrates a typical installation

Nord-Aviation 3400

FLYING AN OBSERVATION AEROPLANE IN PRODUCTION FOR FRANCE'S ARMY

By JAMES HAY STEVENS, AFRAeS

The prototype Nord 3400 seen in this photograph is camouflage-painted, but has the company experimental registration "BTD"

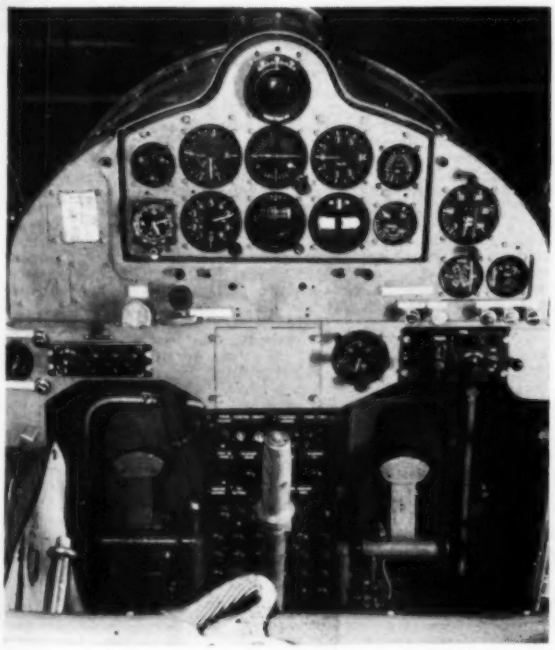
IN 1956 the French authorities put out a specification for a light observation aeroplane for *l'Aviation Légère de l'Armée de Terre*. On January 11, 1957, the DTI announced that the Nord 3400 tender was accepted and manufacture of a prototype began on March 1, with the first flight at Melun-Villaroche on January 28, 1958. Production deliveries are now being made to the French Army and I recently had the chance to inspect and to fly the prototype, identified by the letters BTD.

Primary design objectives were a true STOL performance with full load, extreme manœuvrability and, of course, first-rate view. The high-wing formula is the conventional answer to these needs, but the choice of double-slotted flaps with split-flap ailerons for high lift and effective lateral control down to the stall is unusual. It probably makes a rather lighter, simpler and more easily maintained wing than would be the case with slats and slotted extension flaps. Also, folding wings to permit road transport were specified and, on these, slats would have added an unwelcome complication.

The wing structure is of metal with fabric covering, apart from the leading edge and the inner portions containing the fuel tanks. A single spar, at about 25 per cent chord, is used, with a false rear spar for the flaps and ailerons. There is no centre section, the two wings being attached directly to fittings on the cabin structure and braced by single struts springing from the upper longerons. To fold a wing, the outer end of the strut is detached, the main spar attachment bolts are removed, and the wing is then pivoted till the leading edge is down and it can be swung aft to lie alongside the fuselage, supported on the tailplane. Large handgrips on the wing-tips allow the component to be manhandled conveniently.

For the fuselage structure, welded-steel tubing was chosen as being best for the large cabin cut-outs required. As well as for the engine cowlings, light-alloy sheet is used for the front panels round the cabin, the doors and the detachable rear decking which gives access to the radio; the rest is fabric over wooden formers.

A conventional metal-framed tail unit with fabric covering is fitted, the tailplane being strut-braced. The rudder has a horn balance and the elevator balance carries trim-tabs.



As the Nord 3400 is for the French Army all its instruments have metric calibrations instead of the usual NATO dials

Undercarriage design is simple and effective. The low-pressure (24lb/sq in) E.R.A.M. mainwheels are mounted on fabricated cantilever legs that are hinged to the fuselage with oleo-pneumatic shock-absorbers, of the same make, inside the fuselage. The result is a well-damped high-absorption undercarriage. The steerable tailwheel is also supplied by E.R.A.M. Toe-pedal dashpot-type brakes are fitted to the pilot's rudder pedals, with mechanical connection to the rear pedals.

The Potez 4D, a supercharged inverted four-in-line with a very fair power/weight ratio, is installed with a ram-air intake situated in the top cowling and provided with a full sand-filter by-pass. The two-bladed Ratier constant-speed airscrew is hydraulically operated. One 24 Imp gal flexible fuel cell is mounted in each wing root aft of the main spar.

Cabin layout is commodious (34in average width) and gives an excellent all-round view through the large glazed panels, including "overhung" transparencies for side observation. The pilot sits high, with a forward view on the ground akin to that given by a tricycle-undercarriage aircraft. The rear seat can be turned through 360° for observation duties and access to the map table and radios at the rear. Entry to the front seat is by a large door in the starboard side. The rear part of the cabin has two-piece doors, or hatches, on each side, the glazed sections opening upward and clipping to the wing, the lower parts folding down. On the port side the lower part is longer, to allow insertion (after removal of the observer's seat) of a stretcher for casualty evacuation. French Army equipment includes VHF and HF radio, a homing radio and full night-flying instruments and lighting. Vertical camera, third seat, armour plate, light-bomb racks and catapult gear are available.

Trussed up with a back parachute (having four "dog-leash" clips) and a safety harness not unlike the Z-type, but with *five* straps, one has a somewhat restricted piloting view from the observer's seat, which I tried first. To be fair, the obstruction was largely due to the broad shoulders of Jean Lanvario (Nord's chief test pilot for the Noratlas), because the pilot's seat is mounted higher than the observer's. Dual controls consist of rudder pedals with brakes; telescopic stick; and throttle and radio switches on the left-side panel.

The idea was for me to have demonstration take-offs, powered and unpowered landings and to get the feel of the controls only—since there were no rear instruments in the protoype and, being short, I could see little of the main panel. In point of fact, immediately after the first take-off we did some neat turns when Lanvario thought he had handed over to me, while I was still engaged with the catches of the stick, which kept collapsing itself to a six-inch stub! After an understanding had been re-established I found it easy to do vertical turns from the rear without any reference instruments and little view over the nose, a further tribute to the aeroplane's stability.

In the pilot's seat, though similarly constricted, one feels ready for anything; thanks to the high seat and sloping, sharply-tapered nose, the taxying view is excellent. Perhaps "cut-in" wing root leading edges, as in the Prospector, would improve the already good upward/inward view in turns. The cockpit is comfortable, with its ample width, and, personally, I always like to sit on the centreline with the instruments symmetrically laid out. Flight instruments are in an outlined shock-mounted central panel, which has at its top a raised portion with a spherical-bowl compass. Engine instruments are to the right, with the HF radio controls below; on the left are the ignition switch and starting controls; while on a lower centre panel between the legs is a battery of circuit-breakers. A shelf on the left carries the throttle and airscrew levers and the elevator trim-wheel. The flaps (lowered

The cabin of the Nord 3400, showing the steel-tube framework and light-metal panels. The windows on both sides open upward, the side panels hinge downward (the port one gives stretcher ingress), and the seat swivels through 360°, locking forward or aft

NORD-AVIATION 3400 . . .

by hydraulic hand-pump at the left of the seat and with an engagement button in its handle-tip) are spring-loaded to return when a toggle lever on the side shelf is pressed. The flaps are rather slow to rise on the ground, because they are balanced to the air forces in flight. The flap indicator, of the slide type, is on one of the port cabin frame tubes.

There was a gusty 15kt wind when I tried the Nord 3400; it proved the stability and responsiveness of the aeroplane, but perhaps rather over-emphasized the excellent STOL performance.

Upon opening the throttle, with 35° flap and stick slightly forward, I found that the tail came up quickly and the 3400 lifted off the ground in a level attitude after perhaps forty or fifty yards and at about 85km/hr (45kt) IAS. On raising the flaps acceleration is marked, and slightly more aft trim is needed to maintain the best climb speed of 125km/hr (68kt) which gives some 1,400ft/min and a steep gradient.

Trimmed to level cruise, the 3400 proved unusually stable and docile. The controls are not quite as light as one expects in a French aeroplane and the large span gives considerable inertia in roll, so that I found I tended to slip a bit when changing bank in vertically-banked figure eights. The marked ability to turn tightly on a point, however, is best expressed in Lanvario's words, "she'll turn on a chimney-stack." The stub exhausts, debouching almost under one's feet, make the cockpit rather noisy; but with a headset it was not unpleasant. Incidentally, an occasional "bleep" during the tightest turns finally registered with me as the stall-warning indicator working through the intercom.

Flaps up and throttled, the stall is innocuous and is preceded by light buffeting. With nose fairly high and the stick well back the 3400 can be held in a "mush," using rudder to pick up any tendency for a wing to drop. With 35° flap the nose was lower and there was some pitching, but it could still be held in a mush with the ailerons effective—and by no means sluggish. With flaps up the stall occurred at about 88km/hr (47kt) IAS, and with flaps at 35° it was about 75km/hr (40kt)—even off the clock on one occasion. Although I did not try to prove it, I should think that the 3400 is virtually unstallable with power on and flap. The stall with full flap, 60°, is given as 72km/hr (39kt) IAS, 80km/hr (43kt) TAS.

Approaching to land, it was necessary in the 15kt wind to come well up to the threshold before throttling to 120km/hr (56.5kt) and lowering the flaps to 35°—limiting speed is 150km/hr (81kt) IAS. Slight rearward trim is then needed for comfort, but the elevator load is not heavy. At 110km/hr (60kt) and half-flap the approach was steeper than average. On the final stage, with 60° flap, at 95km/hr (51kt) in that wind the ground seemed to rise almost vertically. Nevertheless, with all controls responding crisply, even though feel was slight, it was not difficult to maintain a steady approach speed using a little power and 2,200 r.p.m. Closing the throttle over the hedge, there was comfortable time to round-out, and—as speed dropped rapidly to the touchdown at 70km/hr (38kt)—to get the tail down (the double slotted flaps at 60° result in a large angular change) to a three-pointer. The undercarriage makes a positive contact with the ground and the aeroplane feels really there in one. The landing run seemed to be only fifty or sixty yards, on the runway and without brakes.

NORD 3400

Powerplant: Potez 4D flat-four; dry weight, 403lb; take-off power, 240 h.p. (4D30) or 260 h.p. (4D34) at 2,550 r.p.m. with specific consumption of 0.675; economical cruise rating, 130 h.p. at 2,000 r.p.m. at 7,500ft (4D30) or at 9,200ft (4D34) with specific consumption of 0.475.

Dimensions: span, 43ft; length, 27ft 8in; height, 11ft 2in; tailplane span, 11ft 10in; track, 7ft 3in; gross wing area, 224 sq ft.

Weights: empty equipped, 2,115lb; fuel (48 Imp gal), 353lb; crew, 397lb; disposable load, 110lb; maximum gross weight, 2,975lb.

Performance (ISA, 4D30 engine unless otherwise stated): take-off ground run (4D34), 360ft; distance to 50ft (4D34), 770ft; initial climb, 1,400ft/min at 2,400 r.p.m. (1,900ft/min with 4D34 at 2,550 r.p.m.); time to 13,000ft, 15min at 2,550 r.p.m. or 18min at 2,400 r.p.m.; max speed, 124kt at 2,400 r.p.m. at 4,250ft; economical cruise, 108kt at 2,000 r.p.m. at 9,000ft; range, 600 miles; minimum speed, approximately 40kt; distance from 50ft, 950ft; ground run, 330ft.

HELICOPTERS IN THE BUILDING TRADE

IN conjunction with the contractors building a school at Yeovil, H. Hoskins Ltd, and Westland Aircraft Ltd, experiments were recently made by Concrete Ltd, in the use of a helicopter for positioning "Bison" pre-stressed concrete purlins weighing about 15 cwt each. A director of the specialist contractors, D. W. Wood, BA, MBIM, AMIProdE, has since prepared an informative paper on the subject, some abstracts of which appear below.

The experiment was carried out in two stages; an investigation into the practicability of fixing precast units directly on to their wall or beam bearings; and, an exercise in precision lifting and handling into position at ground level.

Whilst fixing helicopter-suspended precast units on to 4½in wide bearings at second floor level, without scaffolding, it was found that there was not sufficient purchase to enable men standing on the wall to guide the units on to their bearings, added difficulties being due to the unusual working conditions, i.e., presence of a down-draught of gale force set up by the helicopter blades, and a torque reaction effect on the purlin due to a spinning component in the down-draught.

Exercises carried out at ground level proved to be more promising and focussed attention upon certain basic principles of precise load handling by helicopter. Precast units were picked up by helicopter from a lorry, and carried about 100yd across soft muddy ground, which the lorry had been unable to cross. The helicopter-suspended precast units were then, without much difficulty, placed upon prepared ground-level bearings to an accuracy of 1in.

Precast Unit No.	*Total cycle time to pick-up from lorry, traverse 100yd, and fix into required position, with accuracy of 1in*
	min
1	5.8
2	5.3
3	4.7
4	4.6
5	4.3
6	3.8

Six precast units were placed on to their bearings in this way, the total cycle times per unit being as given in the table in Column 1.

There is general agreement that, with trained operators at ground level, an average cycle time of 4min could be achieved over any distance up to 250yd between lorry and fixing site.

The experiment clearly showed that it is a practical proposition to fix precast units by means of a helicopter but adequate preparations must be made beforehand. These include the following: (1) Provision of a good working platform alongside the bearings, for use of the ground crew when placing a unit in position by means of guide ropes. (2) Special arrangements to prevent the units sliding between the bearings, if slightly twisted due to the torque effect of the helicopter blades or if slightly out of position on first placing. (3) Correct briefing of the pilot, his observer and the ground crew, who must have worked together with units on the ground for a short period before attempting to fix units on to their actual bearings. (4) Provision of adequate protective clothing for the ground crew, i.e., close-fitting overalls, goggles and berets, as used by Army and Navy personnel under similar conditions.

Clearly, the use of a helicopter must be more expensive than employment of the more traditional methods. However, there are circumstances where advantages could be gained by using a helicopter. A typical example would be where the architect particularly wanted a clear span on a building and where access conditions precluded entry of long-wheelbase lorries carrying precast slabs more than 30ft long. Hollow precast purlins 33ft long weigh about 1 ton each and such purlins could be fixed by helicopter at a rate of not less than twelve per hour. Twelve such purlins at 4ft centres would cover a roof area of very nearly 1,500 sq ft, so that the purlins for a roof of 3,000 sq ft could be fixed in about two hours.

It is obvious that at present there are no agreed prices for such operations but, in the not-too-distant future one can foresee helicopter hiring companies offering to carry out precast slab handling and fixing operations for a hire charge of, say, £150 per half-day, or 1s per square foot for the example quoted. Often, the cost of an adequate service road over difficult ground conditions would come to more than the £150 in question. In such circumstances the architect and client might well be prepared to pay this amount to secure the tremendous advantage of a long clear-span building.

FLIGHT SYSTEM SURVEY

The Vickers Vanguard flight deck during the climb from London to the South Coast on a recent proving flight. The three-pilot crew, two of whom can be seen, work close together, surrounded by the features of convenience and roominess which go to make a pleasant and efficient office. At one time five other people stood watching without interfering with the crew

MoA and FAA Exchange Personnel

FOLLOWING an agreement concluded last October, an exchange of technical personnel has now been made between MoA and the FAA. Three members of the FAA Bureau of Research and Development have been assigned to the MoA for two years. They are David J. Sheftel, an electronics engineer; Charles E. Dowling Jr, an air traffic control specialist; and Lt Cdr Homer D. Savage, USN, an operations specialist. A four-man British team should by now have reached the FAA's National Aviation Facilities Experimental Center at Atlantic City, NJ. They are Wg Cdr H. I. Wood, Deputy Director of Control and Navigation Development; W. H. Garnett, Superintendent of the Civil Aviation Telecommunications Engineering Establishment; Gp Capt R. Burns, formerly Commandant of the Empire Test Pilots School; and A. N. Beresford, a scientist attached to the British Joint Staff Mission in Washington.

The purpose of the programme is to exchange information on techniques and systems in communications, traffic control and navigation used by individual countries for the solution of common aviation problems. The American team is particularly concerned with transatlantic navigation. The FAA is also discussing with French, Japanese and Federal German air officials the possibilities of closer working co-operation with those countries.

Automatic Landing by Radar

THE Federal Aviation Agency has begun a six-month trial of the latest version of the Bell automatic landing system at Atlantic City. An FAA C-54 transport and a USAF F-86 are being controlled by the new duplicated tracking radar and computers, autopilot commands being supplied by a VHF radio link operating through the standard ILS receiver in the aircraft. Bell claim that the equipment can land two aircraft every minute from a "gate" position between two and four miles from touchdown. Details of the operation of the system were given in *Flight* for May 16, 1959.

Duplication, a new feature of the system, presumably offers the safety factor required for civil operation, but Bell state that the system controls two aircraft at a time, using both radars at once. For the Atlantic City trials the two radar aerials are mounted together on a trailer and the computer and monitoring positions, manned by two supervisors, are housed in a trailer. A power trailer is also included. It is intended that in any civil installation the computers would be housed in the control tower, leaving only the aerials beside the runway.

With the earlier single-channel military equipment, designated AN/GSN-5 some 4,000 automatic landings have been completed on both airfields and aircraft carriers. Adaptation for civil operation raises a number of problems, and particularly that of whether the airlines will be prepared to trust to ground-based equipment over which they have relatively little control. An important human factor in the system is the fact that the correct settings for any particular type of aircraft must be made on the ground before the automatic landing starts.

The new duplicated Bell automatic landing system under test at the FAA experimental centre at Atlantic City (news item above). A six-month test programme has begun

IATA Technical Agenda

MAIN purpose of the IATA technical conference at Lucerne early in May will be to assess what the airlines have learnt from the first year of world-wide jet airliner operations. About 300 technical and operations experts will come from many countries, representing IATA's 90 member-airlines and also government agencies, air forces, manufacturers, research establishments and other international organizations. The chairman will be Knud Hagrup, vice-president of SAS, who is also chairman of the IATA technical committee.

Principal items on the agenda are:—exchange of views on Doppler navigation, heading references, and navigation computers and displays; review of high level and terminal area ATC problems affecting jet aircraft; cockpit design and layout and presentation of flight information; flight-despatch, take-off and planning procedures; maintenance problems; airline requirements for flight recorders; jet crew-training; minimum noise techniques; and turbine fuel requirements.

Redifon's New Radar Simulator

Now being produced at Crawley, Sussex, is the new air traffic control radar simulator Type C.835 designed by Redifon Ltd. The equipment is intended for the training of civil radar controllers or for the development of new techniques by experienced controllers; and one of its main features is that the controls for the targets are very simple and do not call for trained operators. The prototype system contains four targets in two consoles connected to a Redifon display which is virtually identical with the latest MoA Type 3A display. Each console is on wheels and can pass through the standard doorway width.

The target generators may alternatively be connected to a live radar of almost any manufacture to introduce additional targets. A video mapping unit based on a flying spot scanner can display any video picture which can be reproduced on a phototransparency. The transparency may also be made to move to represent, for example, moving storm centre. For military applications, radio counter-measure simulators may also be added.

During a demonstration last week, one pair of targets was controlled by an operator co-opted at the last minute. He was able to control his two "aircraft" simply by pressing keys to select rate and direction of turn and to set on a dial the heading on which the "aircraft" should straighten out. Speed was set on a linear scale. Target position in eastings and northings may also be read and set on the same pair of veeder counters and a small c.r.t. display will show position without use of the main display. Another key may be depressed to cause the target to orbit at the rate of turn already selected. Six intercom channels are provided between target and display consoles. The complete system may be frozen, leaving the scanner trace rotating but all targets still. Space remains in the system for provision of a height display and more elaborate wind-setting systems if required.

US NON-AIRLINE CIVIL AIRCRAFT: DISTRIBUTION OF RADIO EQUIPMENT

Type of aircraft	Total aircraft in 1957		Aircraft with radio equipment						Aircraft without radio equipment	
			Total		Receiver only		Receiver and transmitter			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Single-engined:—										
One- and two-seat	32,430	100	13,430	41	3,020	9	10,410	32	19,000	59
Three or more seats	28,220	100	26,950	95	2,290	8	24,660	87	1,270	5
Total	*60,650*	*100*	*40,380*	*67*	*5,310*	*9*	*35,070*	*58*	*20,270*	*33*
Multi-engined:—										
800 h.p. total or less	3,290	100	3,240	98	70	2	3,170	96	50	2
801 h.p. to 2,000 h.p.	1,310	100	1,270	97	10	1	1,260	96	40	3
Over 2,000 h.p.	770	100	760	99	*	—	760	99	10	1
Total	*5,370*	*100*	*5,270*	*98*	*80*	*1*	*5,190*	*97*	*100*	*2*
Helicopters, land and sea	290	100	160	55	10	3	150	52	130	45
All other types	210	100	40	19	—	—	40	19	170	81
Total of all types	66,520	100	45,850	69	5,400	8	40,450	61	20,670	31

*Fewer than five aircraft.

US NON-AIRLINE CIVIL AIRCRAFT WITH TWO-WAY RADIO

Type of aircraft	Total	Type of receiver equipment§			
		LF/MF only	VHF only	LF/MF & VHF	VOR*
Single-engined:—					
One- and two-seat	10,410	5,710	580	900	3,220
Three or more seats	24,660	4,020	270	930	19,440
Total	*35,070*	*9,730*	*850*	*1,830*	*22,660*
Multi-engined:—					
800 h.p. total or less	3,170	110	20	10	3,030
801 h.p. to 2,000 h.p.	1,260	20	40	50	1,150
Over 2,000 h.p.	760	†	10	20	730
Total	*5,190*	*130*	*70*	*80*	*4,910*
Helicopters, land and sea	150	10	120	10	10
All other types	40	—	40	—	—
Total of all types	40,450	9,870	1,080	1,920	27,580

*VOR only, or VOR in combination with LF/MF, VHF, or both. † Fewer than five aircraft. §Type of transmitter not considered.

FLIGHT SYSTEM SURVEY...

US Light Aircraft Radio

BRITISH club and executive aircraft with radio are the exception rather than the rule—or should we simply say that British club and executive aircraft are the exception. . ? The American situation is, of course, vastly different, but the extent of the difference and the implications of it may be judged from figures included in a Federal Aviation Agency report issued late last year entitled *General Aviation Aircraft Radio Equipment*. Three of the many tables included in this report are reproduced here to give a general view of the quantity and scale of equipment involved. They were gained by a postal survey made by FAA early in 1958 and were compared in a second section of the report with equivalent figures obtained in 1954. The totals of "general aviation" aircraft were compiled in 1957 and listed, together with the type of flying carried out, in a report entitled *General Aviation Aircraft Use, 1957*.

Of particular interest is the proportion of all aircraft equipped with radio, the proportion carrying only receivers of various kinds and the very high scale of equipment of the twins. Since 1958, the figures will, of course, have increased somewhat. Between 1954 and 1958 the number of radio-equipped aircraft increased by just over one-fifth, but the number of VOR, ADF and ILS receivers more than doubled in most categories and aircraft with only receivers decreased by one-third.

US NON-AIRLINE CIVIL AIRCRAFT WITH NAVIGATION AIDS

Type of aircraft	Total	Type of equipment (other than VOR)			
		ILS only	ADF only	ILS & ADF	ILS, ADF, & DME
Single-engined:—					
One- and two-seat	710	90	580	40	—
Three or more seats	9,090	900	6,530	1,660	*
Total	*9,800*	*990*	*7,110*	*1,700*	*
Multi-engined:—					
800 h.p. total or less	3,020	30	1,090	1,800	100
801 h.p. to 2,000 h.p.	1,220	—	140	1,030	50
Over 2,000 h.p.	760	—	40	560	160
Total	*5,000*	*30*	*1,270*	*3,390*	*310*
Helicopters, land and sea	10	—	10	—	—
Total of all types	14,810	1,020	8,390	5,090	310

*Undetermined.

Decca in South Africa

A REPORT has now been issued by the South African Council for Scientific and Industrial Research concerning trials of the Decca Mk 10 receiver under South African atmospheric noise conditions completed in the Transvaal last November. Decca Navigator Co has for some years been interested in establishing a Decca chain in South Africa and has provided a new type of receiver.

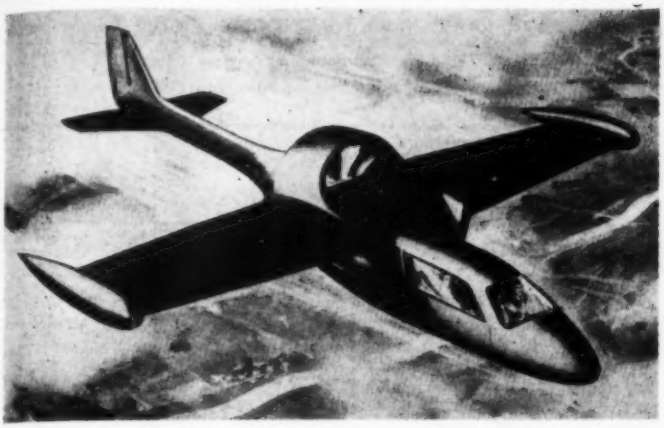
Noise levels for the area, which are at times exceptional, had been established over the years and the tests investigated the working of the various functions in the receiver under these conditions. Detailed results are given in the South African CSIR Research Report No 164 compiled by F. J. Hewitt and D. Hogg of the National Institute for Telecommunications Research. The conclusion states that "the performance of this receiver in atmospheric noise represents a considerable advance on previous designs. Not only are the various functions capable of operating satisfactorily at relatively low signal/noise ratios but, in addition, the Mk 10 receiver possesses the important advantage of automatic lane resetting in the event of loss of signal or false indication for any reason. This facility of automatic lane resetting requires a slightly higher signal/noise ratio than the other functions of the receiver, but this minimum ratio is low compared with previous marks of receiver and is such that, at a range of 250 miles from the normal Decca chain, the probability of serious interruption of service by atmospheric noise is very small and is comparable with, or lower than, that normally expected of electronic equipment from other causes."

As its special representative in South Africa, Decca Navigator Co has appointed Brig H. G. Willmott, CBE, who was formerly Air Chief of Staff in the SAAF.

British Electronics Industry 1959

THE British electronics industry as a whole, as reviewed by the Electronic Engineering Association, is growing at the rate of £30m a year. Gross output in 1959 approached £475m. The industry employed some 350,000 people, and it ploughs back 10 per cent of its annual turnover in research—a percentage second only to that of the aircraft industry itself. Exports of capital goods by EEA members alone were worth £28m in 1959 and are still growing. The proportion of the total industry covered by EEA is between 30 and 35 per cent.

Among the industry's major aeronautical sales have been a radar defence system embodying new and secret automatic electronic techniques, covered by initial contracts worth £1.5m, and being supplied to Sweden. Marconi and an associated French company gained a £7m NATO contract for radar. The Type 984 radar in HMS *Victorious* was most successfully demonstrated to the US Navy. Radar simulator exports have greatly increased and several large communications installations have been provided. Surveillance radar orders have been considerable and airborne radio equipment has been extensively exported. Some Tu-104s have been equipped with Decca Navigator and ILS/VOR airborne equipment has also been ordered by Aeroflot. Russia has purchased £100,000-worth of Pye ILS equipment for Moscow Airport. The first British civil Doppler navigator orders have been placed and the US Federal Aviation Agency has procured several kinds of British equipment for evaluation.



An artist's impression of the German-designed and -built STOL touring aircraft described on this page

Sport and Business

FRENCH TEAM for the World Gliding Championships will comprise Jacques Lachery, Bréguet 905 (standard class); Camille Labar, Bréguet 901S$_2$; and Daniel Barbera, Bréguet 901S$_2$ (both open class). The open-class machines are modified versions of the 901S, having revised flaps and ailerons and improved high-speed performance. Reserve pilots are Jean Paul Weiss and Louis Trubert.

A TOTAL OF 7,689 AIRCRAFT in the "utility and executive" category were delivered by the nine major US companies during 1959. (Retail value of these machines, according to the Aerospace Industries Association, was about $170m, an increase of $35m over the previous year.) The number of aircraft represented an increase of 20 per cent over 1958. Types delivered were:—

Aero. 58 Model 500, 32 Model 560E, 52 Model 680E, six Model 720.
Beech. 89 Model 185, 25 Debonair, 480 Bonanza, 66 Twin Bonanza, 142 Travel Air, 91 Mentor.
Callair. 28 Model A5, 17 Model A6.
Cessna. 648 Model 150, 874 Model 172, 727 Model 175, 258 Model 180, 774 Model 182, 43 Model 210, 240 Model 310 B and C, 24 Model L-19.
Champion. 39 Model 7EC, 91 Model 7FC, 112 Model 7GC, two Model 7GCA, 30 Model 7HC.
Colonial. 17 C-2 Skimmer.
Helio. Seven H-391B, five H-395.
Mooney. 182 Mark 20.
Piper. 470 Super Cub, 676 Tri-Pacer, 311 Apache, 995 Comanche, 78 Pawnee.

BRITISH GLIDING AWARDS for 1959 which were announced by the British Gliding Association on Monday last, are to be presented at the Gliding Ball at Londonderry House tonight (March 11). They comprise:—

Manio Cup for best goal flight, and **Wakefield Trophy** for longest distance: Cdr H. C. N. Goodhart, RN, 360 miles from Lasham to Portmoak in a Skylark 3.

Foster Trophy (first award) for the best speed around a 100km triangle: Col A. J. Deane-Drummond, 43 m.p.h. in an Olympia 403.

de Havilland Cup for greatest gain of height: Philip Wills, 17,900ft in a Skylark 3.

Volk Cup for best out-and-return flight: D. J. Corbett, 198 miles between Lasham and Dunkeswell in an Olympia 419.

Seager Cup for best two-seater performance: M. Kaye and E. T. Martin, 228 miles from Camphill to Dunkeswell in a T-42 Eagle.

California in England Trophy for best flight by a woman pilot: Mrs Anne Burns, 282 miles from Lasham to Hexham in a Skylark 3.

Douglas Trophy for club with best three flights: Army Gliding Club, flights by Col Deane-Drummond, Capt E. G. Shephard and D. J. Corbett.

AT ELSTREE on Saturday, February 27, there was a meeting of a kind all too rare in flying club circles—a get-together of light aircraft pilots and air traffic controllers. Both sides were well represented, the controllers by Geoffrey Monk, Divisional ATC Officer, Southern Division, Arnold Field, Superintendent of the Uxbridge ATC Centre, and W. C. Woodruff, Senior Controller at LAP; and the pilots by members and guests of Elstree Aero Club under David Ogilvy, the chief instructor.

The meeting was informal. First there was a briefing by the three ATC officers (Mr Field is clerk of the Air Traffic Control Officers' Guild) on the development and operation of the control system in the congested south-east corner of England. Afterwards, the meeting was thrown open to questions: "Had the day of the non-radio-equipped light aircraft passed?"; "If control in flight information regions was to be increased [one of the suggestions made by the ATCOs] did this mean the introduction of a standard of control unacceptable to the private pilot or a greater element of danger?"; "What was the minimum radio equipment that controllers thought desirable for light aircraft flying off-airways?"; and "By what means could private aircraft, radio-equipped, be given access into control zones in IMC?"

It was this last question that became the theme for this meeting of pilots with those who control them: "How is the private pilot to be given more freedom of airspace?"

Technically, with the present airways system in south-east England, many problems stand in the way. Radar climb-outs, conflicting approach paths, overlapping of aerodrome circuits, are all considerations that make greater freedom for the private pilot difficult of achievement. But it was the opinion of the three controllers that if sufficient effort were applied to the problem, it might be solved. Earlier they had explained how the control zones and area had grown up in a haphazard fashion. The time might now have come, one suggested, to revise the whole system. The controllers said they would be prepared to consider any constructive proposal likely to ease private pilots' control problems.

FIRST PROTOTYPE of the STOL touring aircraft RF 1 has now almost been completed by Rhein-Flugzeugbau GmbH at Krefeld/München-Gladbach. This six-seater is powered by two 250 h.p. Lycoming engines operating a single pusher propeller. Freewheel and automatic coupling allow independent operation of both engines and ensure automatic disconnection in the event of one failing. Structure is chiefly metal, with considerable use of glass-reinforced plastics. The Custer-style channel wing forms a shroud below the propeller duct. The RF 1 has an electrically operated undercarriage; its useful load is given as 900kg (1,984lb), cruising speed as "about 265km/hr" (165 m.p.h.), range 750km (466 miles) or 1,500km (932 miles) with external tanks.

RETROSPECT

From "Flight" of March 12, 1910

Van den Born Loses His Way in the Air: One of the most remarkable of the cross-country exploits of aviators in France was that of Van den Born, who on Wednesday of last week flew from Chalons to Rheims for luncheon, the journey taking about 20 mins. The inner man refreshed, the flyer restarted his motor, and after making one or two circles flew off in the direction of Prosnes, where he lost his way. Getting anxious, Mr. Henry Farman sent a message to Chalons Camp, and M. Chavez, another Farman pupil, went up to see if he could find his friend. After rising to a height of 510 metres he descried him in the distance, and by this Van den Born was enabled to recover his way. On his return he said he lost himself among the Rheims hills, and descended at Prosnes, where he obtained directions from a farm labourer. Altogether he covered a distance of about 40 miles. Chavez was flying for three-quarters of an hour, and his altitude is the third best on record.

The prototype Challenger, a side-by-side two-seater with 85 h.p. Continental engine. Designed by George Stark of Los Angeles, Cal, it is to be built in Canada by Ultra-Flight Light Aircraft & Development. The aircraft was described in "Flight" for October 2 last year

TEN AIR TRANSPORT QUESTIONS

The New UK Airline Licensing Proposals in Perspective (comment : page 350)

Key Questions	UNITED KINGDOM			CANADA	USA
	Present Methods	Methods Proposed			
		By HM Government	By Bow Group		
(1) *What is the principal source of information in this table?*	Civil Aviation Act, 1949, and Orders & Regulations made thereunder; Air Corporations Act, 1949; and statement of Government policy, July 31, 1952	Civil Aviation Act, 1949, etc; Civil Aviation (Licensing) Bill; Commons Second Reading, March 2, 1960.	"Wings Over Westminster"	Aeronautics Act; The Air Regulations; etc	Federal Aviation Act, 19 Civil Air Regulations
(2) *How is safety controlled?*	(1) Adherence to regulations generally; (2) Approval by Minister's Director of Aviation Safety for new scheduled services	(1) Adherence to improved regulations generally; (2) Issue of "air operators certificate" by Director of Aviation Safety [S.1(2), Bill; S.8, C.A.A. '49]	(1) Adherence to regulations generally; (2) Issue of "general operating licence"; (3) Special permission for "regular services" [p. 67]	(1) Adherence to regulations generally; (2) Issue of Minister's certificate showing that holder is "adequately equipped and able to conduct a safe operation over a prescribed route" (or area) [S.15(5)]	(1) Adherence to regu tions generally; (2) Str regulations and strong forcement (roughly 34 men in the FAA to c with 72,000 aircraft and airline-served airports)
(3) *Do non-scheduled operators need special permission to operate?*	No	Generally yes, with a few exceptions, including small taxi services [S.1]	Yes [p. 28]	Yes [S.15]	Generally, yes [S.401]
(4) *Who regulates air transport services, particularly scheduled ones?*	The Minister, with the advice of the Air Transport Advisory Council (3 to 5 members)	Air Transport Licensing Board (6-10 members) subject to guidance from Minister [S.1]	"Licensing Authority" (around 5 members) [pp. 27 and 28]	Air Transport Board (3 members) subject to approval of Minister [S.15]	Civil Aeronautics Board members plus Examine [S.401]
(5) *Are licensing board members independent of interests in operating aircraft, etc?*	ATAC chairman is a lawyer. Other members may not be members or employees of the Airways Corporations. No member with a special interest may sit on that matter [S.12 C.A.A. '49]	At Minister's discretion—those interested in the business of aircraft or aerodrome operation must advise Minister of the fact [Schedule, Para 7]	Not necessarily a full-time chairman; members part-time [p. 27]	Yes [S.7(7)]	Yes [S.201(b)]
(6) *Are licence applications heard in private or in public?*	Either. In practice they are private. [R.12 SR & O 1947/1224]	Normally in public: "from time to time" in private, e.g. "if issues affecting international relations are being discussed."	Public [p. 27]	Determined by board, believed in public [S.10]	Public, but there is pr vision for certain inform tion or testimony not to made public on applicati [S.1001, R302.39]
(7) *What rights of appeal are there from licensing decisions?*	None	(1) To the Minister generally; (2) By operation of law—to a Court of law on jurisdiction or law	Court of law or a Minister's inspector	(1) To the Minister in the case of suspension, cancellation or variation; (2) To the Supreme Court on questions of jurisdiction or law	To the US Courts Appeals (except generic on questions of fact) [S.10
(8) *Are licensing decisions published with reasons?*	Published, but not with reasons	Unknown	Yes [p. 27]	No specific provision in Act	Yes [S.204(d)]
(9) *What matters are to be considered by the licensing board when granting licences?*	The ATAC has to consider (*inter alia*): (1) Requirements of the public for air transport; (2) Existing facilities and need for avoiding further expenditure; (3) Efficiency and adequacy of existing services; (4) Time for which such services have existed; (5) Having regard to applicant's record the likelihood of safe and regular services; (6) Type of aircraft; (7) Traffic and gross revenue; (8) Suitability and compatibility of rates with other existing rates; (9) Concordance with international agreements of the UK; (10) Any matters the Minister may suggest [Terms of reference, July 31, 1952]	(1) Except with respect to safety matters—the applicant's competence and suitability, having regard to experience, finances, equipment, etc; (2) The need for any air transport service; (3) Adequacy and charges made for existing services; (4) Extent to which "wasteful duplication" might result in a "material diversion" of traffic from existing services; (5) Existing capital expenditure or other commitments by the operator of any existing services; (6) Objections or representations (made by those whom the Minister may subsequently specify); (7) "Any observations made to the Board by the Minister" [S.2(2)] N.B. But the Minister has "the general duty of organizing, carrying out and encouraging measures for the development of civil aviation . . ." [S.1 C.A.A. '49]	General guide to policies: (1) "To provide the development of Britain's air transport industry as a whole"; (2) "To encourage more efficient operation and lower costs"; (3) "To improve the economic position of the two Corporations"; (4) Corporation's share of traffic not "to drop below one half of the national total over the course of the next ten years"; (5) The sterile concept of material diversion should be abandoned [p. 27]	(1) No licence to be issued to a person engaged on other forms of transport unless the Governor believes it is in the public interest; (2) "The Board shall not issue any such licence unless it is satisfied that the proposed commercial air service is and will be required by the present and future public convenience and necessity" [S.15]	(1) The Board will issue licence "if it finds that t applicant is fit, willing a able to perform such tra portation properly and conform to [all relev regulations] and that su transportation is requir by the public convenie and necessity" [S.401(d) (2) *Inter alia*, the Board consider the following m ters as being in accorda with the public convenie and necessity: "(a) T encouragement and de lopment of an air tra portation system prope adapted to the present a future needs of the fore and domestic commerce the US, of the Postal Se vice, and of national de fense;" . . . [cont. in le hand foot-note]
(10) *What matters will the licensing board consider when approving domestic rates and charges?*	See item 8 in answer to question 9 above	See item 3 in answer to question 9 above	See item 2 in answer to question 9 above	They shall be "satisfactory" to the Board [S.13(i)]	If a rate is "unjust u unreasonable or unjustly discriminatory or undu prejudical" the Board m fix the rate having regard to: [cont. in footnote]

(continued from last column, question 9):—". . . (b) The regulation of air transportation in such a manner as to recognize and preserve the inherent advantages of, assure the highest degree of safety in, and foster sound economic conditions in, such transportation, and to improve the relations between, and co-ordinate transportation by air carriers; (c) The promotion of adequate, economical, and efficient services by air carriers at reasonable charges, without unjust discriminations, undue preferences or advantages, or unfair or destructive competitive practices; (d) Competition to the extent necessary to assure the sound development of an air transportation system properly adapted to the needs of the foreign and domestic commerce etc; (e) The promotion of safety in air commerce; and (f) The promotion, encouragement, and development of civil aeronautics" [S.102]

(continued from last column, question 10):—"(1) The effect of such rates upon the movement of traffic; (2) The need in the public interest of adequate and efficient transportation of persons and property by air carriers at the lowest cost consistent with the furnishing of such service; (3) Such standards respecting the character and quality of service to be rendered by air carriers as may be prescribed by or pursuant to law; (4) The inherent advantages of transportation by aircraft; and (5) The need of each carrier under honest, economical, and efficient management, to provide adequate and efficient air carrier service" [S.1002(e)]

THOR IN SERVICE

A Closer Look at the Feltwell Site and its Methods of Operation

THOR ballistic missiles are being put into service in Britain with all the same urgency as that given to the development of the missile itself. By the middle of this year all 60 will be sited in groups of three on airfields spreading from Norfolk through Rutland and Lincolnshire to Yorkshire. The recent opening of the Feltwell site to the view of the world's Press [*Flight*, February 19] was the first opportunity given to the public anywhere to see what nuclear rocket weapons mean in operational terms. If any first impression is justified, it is that the result of the close Anglo-American co-operation to put them into service is a natural marriage of British economy in the use of men and American lavishness in the development of mechanical methods of testing and overhaul.

The four complexes, each with one central base and four satellites, have been built in succession, each drawing on the experience of the others. Little information has been released about those which followed Feltwell; and in spite of the limited number of RAF fields available and the public siting of the missiles, their names and positions have not been released. This article will therefore deal mainly with Feltwell, which in most things has been the prototype for the others.

From the beginning of negotiations about the stationing of Thors in Britain it was accepted that the Royal Air Force would put them into service and provide their bases. When the programme for the missile was just over two years old, in January 1958, agreement was reached between the USAF and the RAF

By LEONARD BEATON

about the requirements for the bases. This cleared the way for the formal agreement of February 1958, which committed the United States to supply the missiles, related specialized equipment, training and facilities for test firings. Britain would provide sites and supporting facilities and the decision to launch would be "a matter for joint decision by the two Governments."

Acquiring 20 new sites in the time-scale which was being agreed would have been impossible, and the RAF decided that airfields were the only possibility. Main bases were put on permanent RAF stations where living accommodation was available and the subsidiary bases were in almost all cases disused wartime fields.

The procedure was in each case to let a contract to civil engineers for the construction of the bases—including launching pads and a receipt, inspection and maintenance (RIM) building at the main base. The Air Ministry Works Directorate completed the designs and let a contract for the Feltwell complex three months after receiving the sketch drawings of the basic requirements. Sir Robert McAlpine & Sons were retained at Feltwell and completed the work on the main site in three-and-a-half months. The four satellite bases took another four months. The other three complexes took about nine months each. Feltwell was started on May 12, 1958, and finished at the end of the year. The other complexes were completed on April 30, 1959, September 29, 1959, and January 28, 1960.

The development of the missile which was going on during 1958 was such as to have an effect on the requirements for the first two complexes. This was the first site ever to be built in the field and to inexperience was added the fact that the work was being done several thousands of miles from the source of information on Thor. By the time the two later complexes came to be built the requirements were largely established.

In general, the specifications were demanding by civil engineering standards, with a permitted error of only an eighth of an inch in line and level. At the launching pads themselves a careful survey had to be made and no settlement could be permitted. Piles had to be driven at some sites, and a total of 490 were used. Extensive excavation was done and a large amount of selected fill was laid and consolidated. Then came base concrete, vibrated concrete and high-quality concrete which on the whole 60 pads came to a total of 235,000 cu yd. Steel frameworks had to be installed with 300ft of steel rails for each missile. The result was a pad in T-form, able to take the missile, its shelter, and its liquid oxygen, kerosine and nitrogen tanks. Roads had to be brought up to the requirements of missile transport and at Feltwell this meant a slight widening of the airfield's perimeter track. Both the Ministry of Transport and the county councils were brought in on the problem of the connecting roads from main bases to satellites (which in one case is 30 miles) and a number of bends were eased. But this proved relatively simple and road building on the airfields themselves was kept to the minimum.

RIM buildings were needed only at the main bases and in each case an aircraft hangar with the required 45,000 sq ft of floor space was available. Most had been built in the pre-war expansion, but their roofs were adequate to the needs of overhead cranes and runner gantries. Full air conditioning was needed, plus dust-proof floors for certain areas, particularly those in which the guidance was to be checked. The American designs had to be adapted to the size of the British hangars, and revised plans were produced for the series of bays in which the test machinery and maintenance men could carry out systems checks. One section was given over to the engine bays and others to guidance and autopilot checks along lines which were familiar for aircraft. The main contrast was that much less space was needed for moving Thors around and that the test equipment was, on the whole, a generation ahead of what the RAF had known. High-pressure air and nitrogen systems were installed, and power supplies of varying voltages and frequencies.

Other buildings, most of which had to be newly erected, included crew rooms at each base, a powerhouse and buildings for storage. Supposedly unclimbable security fencing was put around the whole of each area.

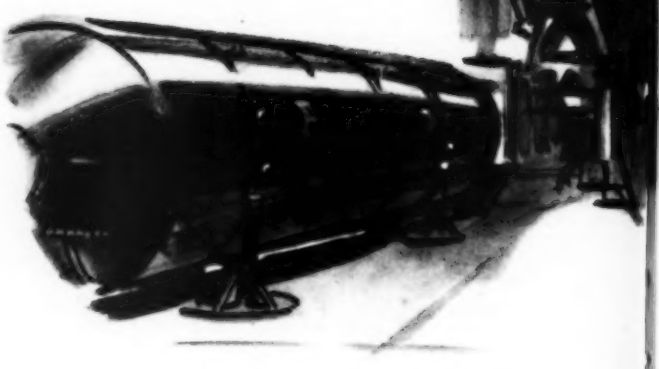
Internal communications, which are an important part of the operational system, were installed by the Post Office. Each complex was given an automatic dial telephone system connecting the satellites to the main base and certain operational lines which remain open at all times. Bomber Command headquarters is able to speak directly to all the sites. The system is based on landlines, but it is insured against sabotage or breakdowns by both multiple routings and a radio back-up in parts of the system.

Finally, electrical services to the launching pads were required. British current was converted to American standards with 200kVA frequency changers and stand-by generating plants were

"Flight" Copyright Drawings
By GORDON HORNER

Left, a Leyland transporter eases a Thor through a partition in the RIM building at Feltwell; right, missile in firing position

The Thor weapon system (WS-315A) includes a wide range of training equipment. The propulsion-system training unit (right) is being used by Ch Tech F. T. McManus to instruct a class on the vernier motors. Below, Flt Lt Kenneth Hunter and M/Sig W. Willis are seen at work in the launch control trailer



THOR IN SERVICE . . .

installed. Each pad needed an extensive earthing system and floodlighting, which was extended to include the security fences.

This series of jobs at Feltwell and its satellites cost the Air Ministry about £1,750,000. This part of the work was a British Government expense under the agreement. By the time it was finished, the men of the Douglas Company, who were the contractors of the USAF for the whole system, including installation, were starting to move in. The Americans accepted the bases as meeting the specification and took over in early September.

Serious domestic problems were created by the arrival of large numbers of Douglas technicians. They were given a hangar of their own, a barrack block, telephone lines and caravan parks, where many of them lived. On some main bases, it was possible to bring US transport aircraft in with the missiles and machinery; but Feltwell was too small and could easily be served by using the big USAF base at Lakenheath. Much of the trucking from Lakenheath was done by the RAF and some of the heaviest equipment came by sea.

One of the first jobs was to align the launch mount and get its position exact. Gravimetric and astro-geodetic surveys had been made outside the sites by the Director of Military Surveys at the War Office. The Americans completed this work inside the sites for the first two complexes and the Air Ministry Works Directorate did it for the last two.

One large piece of construction work was eliminated when the decision was taken to drop the requirement for liquid-oxygen plants on the sites themselves. Reliance was placed on the regular production facilities of the British Oxygen Company's plants. The tanks on the launching site contain enough oxygen to enable a missile to be filled without requiring replenishing for some weeks.

The Douglas men laid out each pad with its liquid oxygen and paraffin tanks on opposite sites and pipes leading up from them into the missile itself.

Nitrogen was supplied from a mobile trailer, a method which also provides a launch control headquarters and power distribution. One of the first things to go up on each site was the heavy shelter for the missile. The Douglas Company employed 450 British civilians in the work at Feltwell and there was general surprise and pleasure at the speed with which things were put in their place. This had been done only on the test ranges, where there were reserves of specialists and equipment for every purpose. The men who came to England to do the job had much to

Kim, and Cpl A. Duxbury of the RAF police, see that all is well as a missile is put through a simulated launch sequence

learn as they went along; and they were not helped by the fact that they were 6,000 miles from the factory and a long way from Cape Canaveral.

The RAF training programme began early with a requirement for 1,000 officers and men for each complex. The total of 4,000 for the permanent manning and servicing of 20 bases may be compared to 9,529 in the V-bomber force itself, 1,457 in the force committed to NATO and 1,525 in the reconnaissance force. The proportion of non-commissioned officers is higher than for flying formations. With the fourth complex only in its early stages, the numbers were: officers, 319; non-commissioned officers, 1,576; others, 1,177. Gp Capt F. A. Willan, the station commander at Feltwell, said that from the point of view of servicing the Thor is more complicated than a Canberra and less complicated than a Valiant. The range of spares holdings (on which a computer in California maintains a constant check and initiates automatic re-supply) is comparable with that of the Valiant.

All personnel were trained in the United States at courses in the firms mainly responsible for the systems: Douglas, AC Spark Plug, Rocketdyne and General Electric. The start was a little slow because the development of the system was going so fast that the technicians did not have the time to spare for training. But the RAF had sent men of a good technical standard and they quickly gained a reputation for learning quickly. They had been drawn from traditional trades and were able to learn the new techniques. The engine specialists found that control and starting had more sequences than they had been accustomed to and the test gear needed advanced electrical knowledge. But most other equipment, such as gyros, was found to involve known methods. The standards of accuracy and the tolerances were more exacting than anything they had experienced, but the mastery of this was largely a question of procedures.

Operationally, the RAF has put each complex of 15 Thors under a group captain. Following conventional RAF practices, he has three wing commanders—operations, technical and administration—but it has been found that the operations and technical staff must co-operate much more closely than in the past. Each base of three missiles is a squadron and has been given an old squadron number plate. The squadron is commanded by a squadron leader, who has five flight lieutenants as Launch Control Officers. At all hours of the day and night, one of these men is in charge of the site and its three missiles.

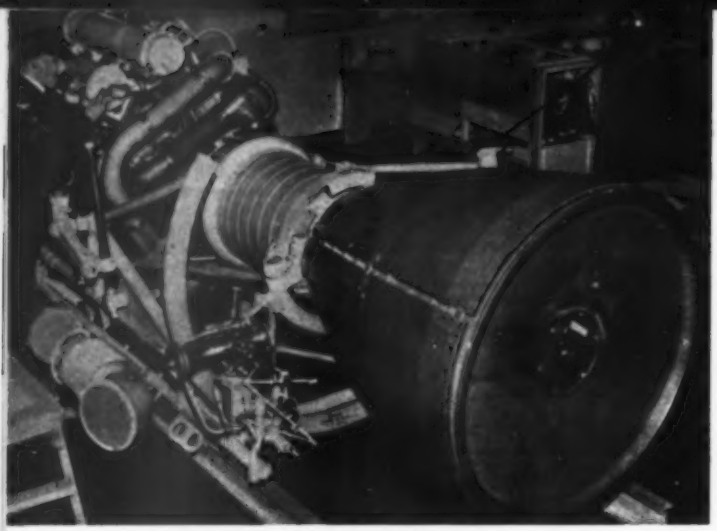
The make-up of the watches (the group of men who fire the missile operationally) is varied from base to base and is being settled from experience. In general, it seems fair to say that the system was lavishly manned in the early days and the numbers are now being cut from experience.

As the first Thors were being put into service, there was, as it happened, a considerable surplus of NCO aircrew. For this reason and to get the missile well-established in service, a category of Launch Control Console Operators was created to look after the countdown of each missile. This took three men in each flight, 15 in each squadron, and 75 for each complex. In addition, each flight was given three crew chiefs, who are responsible for the continuing maintenance of each of the missiles. It soon became obvious that the technical men could be trained to take over the countdown—since if the missile was behaving properly there was nothing to do and if it was not they were needed in any case to put it right. This development coincided with the increased requirements in Transport Command for NCO aircrew and recent squadrons of Thors are being counted down by the crew chiefs.

They with the Launch Control Officer, an American authentication officer, a driver, a cook, a fireman and policemen (with dogs) make up the present watch. But the much larger problem of maintenance must be solved with the right balance between the centre and the sites. Originally, the missiles were to surround a single airfield. Skilled technical people could easily diagnose faults and use the equipment of the RIM building to put them right. With up to 30 miles between RIM building and a site, however, the problem is more complicated. Different methods were tried, and a standard system has now been evolved. In general, the best maintenance people remain at the main depot and go out to the sites with the necessary test equipment when they are needed. This is made much simpler by the extensive monitoring equipment built into the Thors themselves. So far, there has been no occasion when one of the missiles has had to be taken back to the RIM building for servicing.

The close co-operation which must exist between operations and technical staffs is built, in a sense, into the missile itself. Test gear is continuously attached and is not disconnected until the Thors leave the launching pad on firing.

If everything is in order, the firing itself involves almost no manual work. For some reason there is a valve on the liquid oxygen tank which must be opened manually, but otherwise the work of a successful countdown is done by the monitoring machinery. The Launch Control Officer sits in the control trailer with three skeleton panels which give the state of the countdown on each of his missiles. The NCO in charge of a particular one has a visual presentation of the state of his missile. It is possible to fire all the missiles at once and they are all controlled from the same trailer. During practice countdowns, a man usually stands at the launching pad to provide a visual check that the Thor is doing what it should be doing. Through headphones he checks the operation of some element of the system by listening for certain valves and other parts. For a time there was trouble with the



Rocketdyne's plant at Neosho, Missouri, has now delivered a large number of MB-3 engines for the Thor. This MB-3 is seen on its stand in the Feltwell RIM building; and immediately in front of it is one of the verniers. Theoretical horse-power at burn-out is about 6,000,000

THOR IN SERVICE . . .

interlock between the raising of the missile and the retraction of the shelter—the one coming undesirably before the other.

In a case like this a man on the site can push the "panic button" and stop the procedure. But well before the lighting-up of the vernier engines he withdraws to the 200yd distance of the control trailer.

The precise reaction period of these missiles in normal times of peace is not known. All that the RAF will say is that "we must be capable of launching them at any hour of the day or night within 15 minutes." That is not to say that they are at 15 minutes' readiness. The control over the missiles is very strict and formal both by the Royal Air Force and the United States Air Force. The British key initiates the countdown and at a certain stage the American authentication officer releases the warhead for operational use. Thus the USAF officer cannot initiate a countdown; he may only hold it up if he has not received authority to release. These keys are treated with care, handled formally, and move from watch to watch according to set procedures. Operational control is thus indisputably in British hands.

British orders come from the headquarters of Bomber Command. American orders are received through Strategic Air Command from its commander-in-chief, the President. The American element in the Thor system comes under the SAC 7th Air Division, with its headquarters at South Ruislip.

The Americans have 36 officers and 50 senior NCOs at Feltwell, including their authentication officers. They have complete responsibility for the possession and maintenance of the warheads and as the RIM building is entirely under the control of the RAF it is obvious that even the maintenance does not happen there. Presumably the Americans have their own servicing building and procedures; but neither side is prepared to say anything about where warheads are kept, when they are attached to the missiles, or how the needs of 15 minutes' readiness can be met.

There is every reason to believe, however, that the warheads are not normally maintained on the missiles in normal times. If the testimony of General Power, the commander-in-chief of the Strategic Air Command, is to be believed, the USAF is not prepared to fire missiles on the evidence of radar identification. These Thors have no means of destruction once airborne and can only be launched in the sure conviction that an atomic war is irrevocably on. They must therefore presumably expect to ride out a first attack; and the concern of the United States Government about passing nuclear weapons into other hands is likely to be reflected in procedures which err on the side of safety and poor reaction time. The procedures will, after all, be applied to many besides the British. If this is the case and the warheads are not normally kept attached, it would take what was officially described as "a number of hours—not many" to fit them. Otherwise a countdown would take a little more than 15 minutes, but the aim is 15 minutes or less. Until quite a late stage in a countdown, incidentally, a new target may be read into the missile.

Doubts have been expressed about the value of a missile on "soft" sites so close to the Soviet Union. Obviously what value there is in the Thors has been multiplied five-fold by the decision to spread them out in parcels of three. This would impose a large number of targets on the Russians if they proposed to launch a surprise attack: indeed, if it is assumed that they must fire three times to be sure of each target, it would take 60 missiles to destroy 60 missiles. This would be "counter force" warfare in its purest and most futile form.

But the Russians must surely ask themselves whether these 15 bases (which they can have had no difficulty in charting) are the only possible ones. Are there some hidden Thors somewhere? Has someone buried the occasional one or two in an ancient coal workings or in some isolated part of an old artillery range? Even in Britain there is plenty of room for concealment.

Whether or not these are the only 60, at least 45 of them are on their sites in the hands of men who understand them. In the 24 development firings of the Thor up to January 1959, ten were successful. In the following year, 22 were fired of which 20 were successful, one partially successful and one a failure. At regular intervals a British squadron will take one of its missiles to Vandenberg Air Force Base and fire it to see that it is still fully operational. The West, in short, has its first vulnerable batch of ballistic missiles. They are showing the way to what may be the hundreds or even thousands which come after.

THE DEBATE ON THE AIR ESTIMATES

IN his speech on the Air Estimates on March 2 the Secretary of State for Air, George Ward, said that the net total of the Estimates for the next financial year was about £527m. This was about £37m more than our total expenditure in the current year. The largest increase was in the Vote for aircraft and stores, mainly accounted for by increased expenditure on armament and, in particular, guided weapons. Expenditure on aircraft remained more or less constant.

The RAF could get four V-bombers into the air from one airfield in less than four minutes, said Mr Ward, and they were already working on equipment and installations which would enable them to get this time down lower yet. Average bombing accuracy in Bomber Command had doubled since 1957.

Mr Ward's references to the American air-launched missile Skybolt are quoted in a leading article in this issue. The Minister went on to say that in Fighter Command the SAGW system was expanding fast and that a programme of operational firings of Bloodhound was going on at Cardigan Bay. About 70 per cent of recent firings against pilotless aircraft had resulted in kills and a remarkable number of these had been direct hits.

Of jet transports Mr Ward said that both the Comet 4 and the VC10 were being "looked at"—as was "a combination of the two." Amplifying this phrase "a combination of the two" Mr Ward said ". . . We think that the VC10 will be a great step forward in range, speed and so forth, but it is not certain exactly when we could have it. It may be necessary to fill in with some Comets in the meantime, which would still be useful for other purposes even when we have the VC10."

"This year," he continued, "we are getting our first Bristol 192s, the twin-rotor helicopter which we have decided to call Belvedere. Orders are being placed for the new turbine-engined Whirlwind, which will have a very much improved performance, and this will more than treble the helicopter lift at present available to the Army."

Later in the debate the Under-Secretary of State for Air, W. J. Taylor, said that 20 Argosies had been ordered, that 20 more would be ordered shortly, and that the first should be in service by 1962. Concerning the Britannic, he said that the Minister of Aviation and the firm were being pressed to get on and get the contract signed. In Mr Taylor's view there had been too much delay already.

MARTIN-BAKER ACQUIRE CHALGROVE

CHALGROVE AIRFIELD, Oxon, has been sold by the Government to the Martin-Baker Aircraft Co Ltd, who have been tenants for some 14 years. The decision, announced recently, has heightened feeling among local residents, who have for some time past been protesting against continued use of the airfield. An Air Ministry letter to John Hay, MP for Henley, emphasizes the great importance of the work being carried out by Martin-Baker and says that the saving of lives depends on its continuance; "it is vital to military flying in this country and is valuable in the most important field of export." There were no airfields which would provide a reasonable alternative within 70 miles of the company's works at Denham.

The letter goes on to say that test flights which could cause the most disturbance are those very occasionally carried out at high speed and at an altitude of about 50ft, but it had been decided that such flights should be carried out elsewhere in the future. For the rest, apart from communication flights, there would not normally be more than one or two test flights a day, and most of these would be at 500ft or above.

The four Fairey Gannet AEW.3s of No 849A Flight, which now form the early warning element of "Ark Royal's" aircraft

GANNET AEW.3s JOIN THE FLEET

700G BECOMES 849A FLIGHT

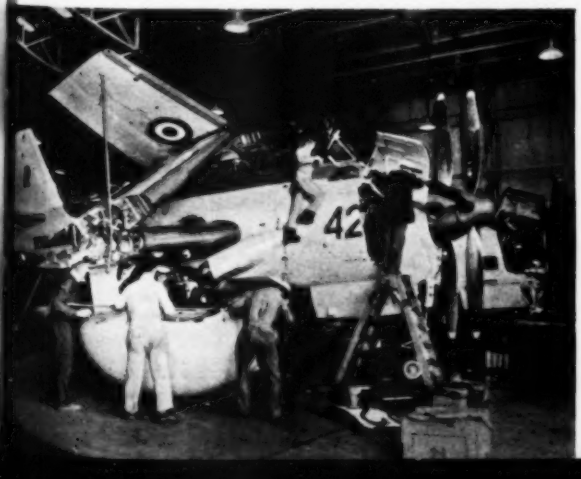
JUST over a week ago the recently formed 849A Flight, equipped with Fairey Gannet AEW.3s, embarked in HMS *Ark Royal*. Also in the carrier, which has undergone a 14-month refit at Devonport, are two Scimitar squadrons (Nos 800 and 807) and one of Sea Vixens (No 892). This complement means that for the first time all the Royal Navy's new generation of aircraft, except the NA.39, will be embarked together—a formidable force of all-weather fighters with the Gannets acting as airborne early-warners.

In this role they succeed the Douglas Skyraiders, which up to now have been the equipment of 849 Flight. Divided into 849A, -B, -C and -D, it has provided the Fleet carriers with radar information in the same way that land-based stations inform the RAF intercepter squadrons. Ultimately the whole of the Flight will have Gannet AEW.3s and the Skyraiders, which have been in service since 1952, will go into retirement. Proving of the AEW.3s has been done by 700G Flight, whose remarkable work at HMS *Seahawk* (RNAS Culdrose, near Helston in Cornwall) since August last year sent *Flight* down there recently to meet the men concerned and hear at first hand how they had managed to do so much so successfully with a new type of aircraft in such a comparatively short time.

The CO of the former 700G Flight, Lt Cdr W. Hawley, described the work they had carried out and also the operational context into which the AEW.3s were to be fitted. The Flight received two aircraft on August 17, 1959, and about a month later this number was increased to three; then in December reduced to two again when one of the machines went back to the manufacturers. The trials were completed on January 31 this year and on February 1 the unit became 849A Flight, signifying the entry of the AEW.3 into Naval service. In the trials period, a total of 1,855hr 15min flying was achieved, 222hr of this at night (a total of 240hr IF was flown). Out of 124 days available for flying, 124 days were used. 700G flew an average of 16hr 17min per day, flying each weekday, with Saturday a half-day. On the average the unit had five pilots (this number going up to six occasionally, and sometimes down to four) and ten observers.

This phenomenal amount of flying was all done during normal airfield opening hours, that is 0800 to sunset or 1800, whichever was earlier. To maintain the aircraft, 700G Flight had 60 ground-crew, who embarked in *Ark Royal* with the newly constituted 849A Flt. During the working-up period, maximum use was made of manpower by operating a two-shift system. Half the day watch would come on at 0645, going to breakfast at 0800 when the other half started; by this hour the aircraft were always airborne. The night watch started at 1645, giving half-an-hour's overlap between watches, and usually finished at 0245 or worked as late as necessary. The day's work normally ended at 1700 and the flight did not work on Sundays. What this regularity amounted to, in Lt Cdr Hawley's words, was "a high rate of flying with not such a lot of maintenance." The AEW.3s have already achieved the same engine life as the old Gannets.

"Flight" photograph



One purpose of 700G Flight was to give the AEW.3 a reliability trial, flying 300hr on each aircraft and suggesting modifications where they appeared necessary. Initially there were some engine troubles, and engine changes had to be made during the first five weeks. But Lt Cdr Hawley, in saying this, was quick to point out that the engines concerned were pre-production ones. They had had no trouble with later powerplants. An indication of the reliability of the late-series Bristol Siddeley Double Mamba is that a life of 200 units either side was originally aimed at, one unit being the equivalent of 1hr 6min flying time. But in fact 370hr flying had been got out of these engines. On this experience, the manufacturers will decide, after stripping-down and a conference on what they find, whether to grant an extension of life. During the working-up period, representatives from Fairey Aviation have co-operated closely with the Flight's AEO (engineer officer), Lt E. T. Harris, and ALO (electrical officer), Lt Cdr S. R. Hirons. In the trials period, the aircraft were flown with a 45min turn-round between trips, though this time was often reduced, on one occasion to only 31min. Over the whole period, one of the machines did 670hr flying and another 625. There was an average availability of two aircraft during the trials. These figures speak highly for the reliability of the AEW.3 and its engines.

Lt Cdr W. Hawley (right), who commands 849A Flight, with his senior pilot, Lt Cdr (P) W. H. Barnard, who is a South African

"Flight" photograph

To assist in passing on technical know-how about the new aircraft, a Royal Navy special maintenance party who had been with Fairey since the AEW.3 first flew—two officers and six petty officers—carried out all maintenance on the aircraft at Culdrose for the first weeks after 700G Flight formed there. (All the airframe and engine artificers on the flight have been given a course with the manufacturers.)

Lt Cdr Hawley could not speak too highly of the co-operation between his unit and Fairey Aviation, describing it as "phenomenal." One aspect of this co-operation had been steady commuting between Culdrose and White Waltham by a Gannet Trainer which, because of its regularity, was known as Wells Fargo.

The CO also spoke enthusiastically of AEW.3 reliability. One

Maintenance personnel of the Flight doing an acceptance check on one of the aircraft at RNAS Culdrose, shortly after the machine had been received from the manufacturers. The wing folding, which reduces the span from 54ft 7in to 20ft, is clearly shown in this picture

The AEW.3s are operational by night as well as by day. In this silhouette view the outline of the radome can be clearly seen, as well as external features like the retracted arrester hook "Flight" photograph

GANNET AEW.3s JOIN THE FLEET . . .

of the aircraft on the Flight had done 670hr by the time of our visit, and another one 625hr; and there had been an average availability of two aircraft over the whole period of the trials. Each aircraft had been fully serviceable every time it was flown; certainly the Flight never took an aircraft into the air unless the radar was working. Summing-up reliability, the CO said quite simply: "Figures speak for themselves as far as maintenance is concerned."

During the trials, a weekly report was compiled by all RN executives primarily concerned with the operational and technical aspects of the aircraft—700G's commanding officer, senior pilot, senior observer and engineering and electrical officers. These reports have had a wide distribution, and partly account for the great interest which the AEW.3 trials have aroused. The Flight had many visitors during its time at Culdrose, and the information they were given often led to assistance in return. One manufacturer's representative who was on holiday in Cornwall called in and said he had only a few minutes to spare, but stayed for four days.

The trials provided not only a thorough work-out for the aircraft, which carries a most complicated electrical system, but also operational training for crews who are to fly the AEW.3s from carriers. During these trials, the machines at Culdrose were flown within the Boscombe Down envelope but in that area all possible exigencies were investigated. Normally the AEW.3 is cruised on only one of its engines (which are entirely independent), power being changed to the alternate unit every hour. A measure of the crews' trust in their powerplants is shown by the fact that this single-engine procedure is now carried out impartially by day and by night. At Culdrose, all pilots concerned in the trials achieved well over 300 hours' flying and some of the observers more, one topping 400hr. Four aircraft were being taken aboard *Ark Royal*, one of them a veteran of 100 hours' flying, the others new recruits. 849A's aircrew complement is five pilots and ten observers, forming four crews and one spare crew.

In the AEW.3s, the two observers sit side-by-side in the rear cockpit, and during *Flight's* visit to Culdrose the writer had an opportunity of sampling this situation during an air-to-air photographic sortie. It is not permissible, for security reasons, to describe the equipment which faces each observer though one can say that this will provide the Fleet with much wider-ranging early-warning facilities than ever before. But it is possible to say that each observer's position provides comfortable working surroundings without an unduly high noise level; and it is fair to assume that from the assiduous character of their work-up—described by Fairey Aviation as "the quickest development and trials programme in recent years"—No 849A Flight will efficiently fulfil the duties exemplified in their motto, *Primus Video* (I see first), with a radar visibility as powerful in penetrating the sea depths as in searching the sky. H.W.

Members of the former 700G, now 849A Flight, whose hard work in proving the AEW.3 is recorded on these pages. The two civilians in the front row are G. Richards, Bristol Siddeley representative (left), and G. R. Lansdowne (Fairey Aviation)

One of the AEW.3s, flown by Lt Cdr Hawley, demonstrating its energetic rate of roll with Falmouth as background "Flight" photograph

Straight and Level

DO you know what this week's Straight and Level photograph depicts? Yes, it's a sort of fan. And it is also a monument. Specifically, it is the aft-fan augmentor of the Metro-Vick F.3 gas turbine of 1945—a pretty historic piece of British aeronautical hardware. It was photographed the other day at the offices of Power Jets (Research and Development) Ltd; and I find that the new aft-fan engines for America's fastest airliners are licence-built under the Power Jets patent. So don't believe it when you hear that America's jet-debt to Great Britain was paid off years ago.

As you might suppose, this type of two-tier aft-fan was another invention of Sir Frank Whittle's, and an example was actually fitted to a Whittle engine before the war ended.

When I add that a similar scheme was intended for the *supersonic* Miles M.52, *designed in 1943*, you will find yourself wondering, as I am, how many years of British aeronautical progress were eaten up by the locusts of irresolution and apathy.

● The terms of reference of Britain's proposed new air transport licensing board do not require the board to take into account the public interest. This curious omission, noted in *Flight* for February 26, was mentioned during the second reading of the licensing bill in the Commons on March 2 by John Rankin, MP, to whom we should all be obliged.

Government regulation should have in mind, above all things, the protection of the public interest. The protection of an airline (or whatever is being regulated) should be determined in the light of the public interest. This may or may not require the protection of the airline; but do let's put first things first.

In this context I recommend to all those who are now re-shaping the destiny of British air transport the following enlightened remarks. They are attributed by *Time* to Pete Quesada, chief of the US Federal Aviation Agency:—

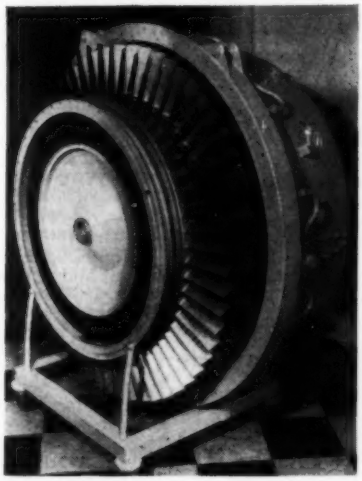
"The whole philosophy of Government regulation is to protect the public's interest. But history finds that the public is silent; the public sits there and just hopes that the agency that it set up will take care of its interest."

● Notice in the office of Tex Johnston, Boeing's chief of flight test: "One test flight is worth 100,000 expert opinions."

Well may you wonder whether, in Boeing's aerodynamics department, the visitor is invited to believe that one expert opinion is worth 100,000 test flights.

● If the proposed ballistic missile early warning station at Fylingdales, Yorkshire, is anything like the giant detection radars at Clear and Thule, it will look along a 30 deg segment of great circle into the USSR. This would embrace the entire Communist land mass; but it doesn't need a genius to see that it will be useless against something chucked up from a submarine in the Atlantic.

There are many other questions that need answering. Should Britain pay £8m towards a warning system that won't actually help *us* very much? ("Cheerio, chaps," and all that). Is it all so secret, or was it described in this journal on January 29? Why can't it be made to swivel in all directions? Will it affect TV reception? Good gracious! —TV reception. This is serious.



Ancient British monument—see first item

● Can you decide from an interview, even a very thorough interview, whether a man will make a good pilot? This important question—important because the training of pilots is very expensive —was answered by a contributor to Flight of February 26. It may be repetition, but repetition does lend re-emphasis to a good point:—

"It is a known fact, incontestably established during nearly half a century of flying training, that aptitude to fly and command an aeroplane is one of the most difficult of all human accomplishments to predict on the ground. The complex combination of personal qualities needed is such that there is no simple yardstick by which they can be measured during an interview or test. It is not, unfortunately, just a straightforward question of assessing manual dexterity, co-ordination, or speed of reactions. . . . All that we know for certain is that aptitude for piloting an aeroplane is an ingredient of character. . . . There is no significant correlation between this aptitude and those other personal qualities which can be assessed on the ground."

● The other day a colleague, flying in an airliner from Paris to London, stood in the cockpit and watched three extremely busy pilots managing the airways procedure, tuning their radios, making their calls, climbing, cruising for a few minutes at 15,000ft then descending over the Epsom stack on to 28L.

The weather was gin clear with a visibility of at least 30 miles. It occurred to him that incessant manipulation of two ADF and VOR receivers, ILS and marker receiver seemed ridiculous when the crew could, if they had time to look out of the window, see the whole of Kent and Sussex, the Thames estuary and the south coast of England spread out below like a map.

I would be the first to deplore the skimping of mandatory procedures. But are pilots perhaps becoming the servants of radio aids?

● Unlike the *Daily Clanger*, whose angle on British aviation is always in terms of supersonic British wonder jets etc, the *Daily Express* ran a front-page headline story the other day on the homely subject of a 56min flight in a propeller airliner. Repeat—a front-page story.

The headline was: "THE WORLD BEATER—It's faster than jets on short journeys." And it was about the Vanguard, the aircraft "that can become the sky bus of the world . . . a plane to inspire a vision of an age of mass air travel . .

"Her running costs are low," the story went on. "So low, say Vickers, the makers, that she could slash European fares by up to a half. . . . On short routes the jet-prop's point-to-point operation can be quicker than the fast pure jet, which is forced to climb much higher. . . . Not for several years will the pure jets be able to match the Vanguard type of economy on short-haul routes."

This was not a warmed-over handout published by a trade paper, but a signed article on the front page of one of Britain's most news-conscious popular dailies. I am afraid that it upset my old friend Sir Charles Boost, supersonic speed champion, very much indeed.

● It is Government policy to support a supersonic airliner. Good: no one advocates that our technology should henceforth mark time. But though there will be a demand for supersonic transports, they won't bring costs down. There will be a much bigger demand for low-cost air transports. What is the Government doing to create the conditions in which this demand can flourish? Support of supersonics is only half a policy.

Gracious Living Dept

● "Also recently installed in the Club is an electric oven. This can be used for heating pies, soup etc. It is also hoped that it will discourage people from boiling soup in the electric kettle."—*Armstrong Siddeley Flying Club newsletter.*

ROGER BACON

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Middle East Mystery

REFERENCE the mystery of the Blenheim aircraft found in the Cyrenaican Desert. I can throw what may be a little light on the subject. I was serving on the Air Staff at Headquarters Middle East from November 1941 to October 1942 and during that time, exactly when I don't remember, a party was sent by air to do a recce of Kufra Oasis, I think with the object of finding possible forward landing grounds in the area.

Whatever the reason for the expedition, I remember that it was undertaken by a SAAF crew, if not a SAAF aircraft. They disappeared and the aircraft was not located for some weeks, after it had been assumed that the crew had got lost and run out of fuel. They were not hurt in the landing and there was evidence that they had lived for several days, trying to attract attention. They eventually died of thirst, having drunk everything liquid including, I was told, the alcohol in the compass.

It seems quite likely that this tragedy is the explanation for the presence of the aircraft under discussion.

RAF Horsham St Faith — J. A. LEATHART, Air Cdre

WITH reference to Peter Masefield's letter in your issue of February 26 on the mystery of a Blenheim found in the Cyrenaican Desert, I can help to the extent that the letters RC and CE were allotted to aircraft of No 5 Lancaster Finishing School, which started up, with myself as chief instructor, at Syerston on January 15, 1944.

The Blenheim, therefore, was most probably one of No 162 Squadron's.

London SW1 — W. G. GARDINER, Wg Cdr

"Two-six!"

THE question as to the origin of the order "Two-six!" asked by J. F. Graham under the heading "Incantation" in your issue of February 26 is one that has always interested me.

I once asked my flight sergeant if he could enlighten me and he went to some bother to explain that, at one time, nothing could be moved in the RAF unless a Form 26 had first been completed and signed by a senior NCO.

Whether this information is, or was, correct I have never been able to determine, but perhaps someone in the stationery supply department of the RAF could find out for us. But I can assure your correspondent that some pretty heavy monoplanes were also hustled about during World War 2 as the result of the order "Two-six!"

Hounslow, Mddx — H. F. COWLEY

THE solution of Mr Graham's problem lies in the text of his query. The phrase "Two-six!" in fact referred to the number of men deemed necessary to impart motion to an aircraft for ground handling purposes; two at the tailplane and six at the leading-edge of the mainplane.

"Two-six!" passed into generic usage as an expletive, liberally employed by NCOs to stir their subordinates into vigorous activity.

York — S. B. PEEK

MR GRAHAM'S "Two-six!" query is one that puzzled me for several years, but its solution is simple. The phrase, still in use today, is part of our great Naval heritage. When the eight-handled capstan was in use the men on the ends of poles two and six were opposite one another and acted as "strokes" or "cheer-leaders." Hence "Two-six, everybody heave!"

Bristol 6 — C. E. P. HARRISON, Fg Off, RAFVR

Spitfire in Perth

NOT often does one find in the pages of *Flight* a mistake in the designation of an aeroplane, but I believe I have found one on page 218 of your issue for February 12. The photograph there depicts a Spitfire on a stand in Perth, Australia, and the caption names it as a Spitfire 22. I humbly beg to differ. As soon as I saw the photograph, I at once recognised it as a Mk 24, the very last of the Spitfires.

Basically, the 22 and 24 were almost identical, apart from the fin and rudder. On the 22, the rudder was as fitted to all the later marks of Spitfire, 14, 18, 19 and 21. On the 24, however, fin and rudder were completely redesigned. They were a lot taller than the earlier type, but of narrower chord.

The part that puzzles me is the registration number of the Perth Spitfire. I have no doubt in my mind that it is a 24, but its number (PK481) suggests a mark of earlier vintage. I have records of 22s with PW registrations and a PR19 with a PS prefix, but have nothing earlier than VN for the 24.

Bearing in mind the fact that the Spitfire was produced in such large numbers, numerical inconsistency in the registrations could easily have occurred; but I do not think that such a difference between PK and VN is possible in a version that was produced in such small numbers compared with the earlier marks. I thought, perhaps, that it might have been the prototype, but I have no details of that aeroplane in my files.

Many Mk 24s were built from existing Mk 22 airframes and modified with the new fin and rudder; in all, I believe, 70 Mk 24s were built.

I hope it will be possible to see, at a later date, a photograph of the Spitfire resplendent in its correct camouflage and markings. It will be interesting to see if the organizers finish the aircraft correctly.

Duxford, Cambs — K. N. TILSON

[Vickers-Armstrongs (Aircraft) Ltd have assured us that the Spitfire illustrated is indeed a Mk 22. The later aircraft of this Mark had the same pattern of tail as the Mk 24 and, for that matter, the Spiteful.—Ed.]

Aircraft for the Army

WE in Britain can be proud of the standards of safety in aviation, but can we be proud of our standards of obsolescence? A recent report states that the USAF is to sell its DHC-2 Beavers within the next year or so, yet at the same time our own Army Air Corps will be forming its first squadrons of these aircraft.

Since we are already about five years late in ordering machines of this category could we not have waited a further two years and obtained a brand new design to fill the gap: the Scottish Aviation Pegasus?

Glasgow — OVERBURDENED TAXPAYER

[Several hundred Beavers are in service with the US Army and Air Force and have given complete satisfaction. These aircraft are to be retired only when their age makes their continued operation uneconomic.—Ed.]

Trans-Troodos Airlines

AS one who has been a number of times privileged to fly with the Middle East Air Force on visits to RAF medical establishments, I would like to express appreciation of the article on it in *Flight* for February 26. I would also like to add a small note on a characteristic RAF activity in Cyprus omitted from this otherwise comprehensive account. It is the "Trans-Troodos Airlines," which functions with unfailing regularity between Akrotiri and Nicosia (a 20-minute flight over the mountains). On this I travelled several times last year. On one occasion, in a single-engined Pioneer, we hopped around gaily delivering and collecting mail-bags from various airstrips. But always we sailed over the snow-covered and deeply cleft mountains smoothly and serenely. When I commented on this to our RAF pilot, he said characteristically, "Oh, that's a piece of cake. But it's a bit more difficult dropping food in those valleys from fifty feet."

London SE1 — J. ELISE GORDON (Editor, *Nursing Mirror*)

The Transport Airship

REVERTING to the article by Peter Brooks in *Flight* for December 25 last, I suggest that a strong case can still be made for the airship as a long-range transport vehicle.

There are, admittedly, a number of factors which militate against the revival of the large rigid; among these are the prejudice and ignorance concerning airships, the powerful vested interest in the aeroplane (upon which astronomic sums have been lavished and in comparison with which, the amount spent on airship development has been but a drop in the ocean), the dwindling number of those qualified to design, build and operate airships, and the comparative lack of commercial operational experience.

But the principle of buoyant lift, derived from the displacement of air by a lighter gas, is perfectly sound provided that it is sufficient to support a vehicle strong enough to sustain all the forseeable stresses of flight while carrying a commercially adequate payload over the required distance. The German Zeppelin *Hindenburg* satisfied the strength requirement, and if she did not quite achieve commercial success—an arguable point—there seems little doubt that technical advances during the intervening two decades would enable a modern airship to do so if the determination and financial backing should be forthcoming; they still may be so in Germany, where Captain Pruss, the former commander of the *Hindenburg*, maintains an undaunted advocacy and where there are still designers and constructors with the "know-how."

Commercial prosperity can hardly be claimed at the present time either for the ocean liner or for the long-range transport aeroplane. What can the airship offer? The answer is, comfortable, safe and reasonably fast travel, possibly at lower fares than those of contemporary ships and aircraft. [*Continued on page 347*

CORRESPONDENCE . . .

Over 20 years ago the *Hindenburg* offered standards of comfort approaching (and in one respect surpassing) those of the ocean liner, for her motion in bad weather was quite small. She was designed for inflation with the inert helium gas, and if this had not been withheld the disaster at Lakehurst could not have occurred. It is true that three American airships filled with helium were lost, but a recurrence of those accidents is avoidable today. *Shenandoah* flew into an altogether exceptionally severe line-squall with very violent vertical air currents and broke up—a fate which would almost certainly have overtaken an aeroplane and with greater loss of life. Storm-warning radar should obviate this danger. *Akron* flew into the sea as a result of a faulty altimeter reading and not through any deficiency in the ship herself. *Macon* was sent on a fleet exercise with a tail-fin with a known structural defect. When this collapsed she had to make a descent in the sea. This accident need not have happened. In Britain, R.38 broke in half during turning trials because no attempt had been made to calculate the dynamic loads to which the hull would be subjected in flight, while the catalogue of errors revealed by the inquiry into the loss of R.101 is so appalling that one can only be surprised that this disaster did not occur earlier. (Details of both these accidents will be found in Command Paper 3825 of 1931 and in Nevil Shute's autobiography *Slide Rule*.) It is a sad fact that most of the accidents to rigid airships could have been avoided; however, the lessons then learned can be applied to preventing similar occurrences in the future.

The airship, relying for her support on buoyant lift, has an inherent safety lacking in the aeroplane, which cannot fly slowly or stop in the air and which loses its power of flight in the event of a major engine failure or fuel exhaustion.

When speed is vital a traveller will choose the jet airliner (thought these, too, can suffer lengthy delays on the ground at the start and inconvenient, time-wasting diversions on arrival as a result of fog, electronic aids notwithstanding). But for the majority the performance of a modern airship, which could fly between London and New York in the course of two nights and the intervening day, should be quite adequate, and the loss of one working day acceptable.

Finally, while it is difficult to make more than an inspired guess about the economics of airship commerce, the following pointers support the contention that this should prove profitable.

Hindenburg, which during her short life came close to commercial success (if, indeed, she did not attain it) carried fuel for 7,000 miles' flying, i.e., a 100 per cent reserve on the North Atlantic run. A faster, modern airship, less affected by contrary winds, could safely operate with a smaller reserve. It should be possible to improve on the specific fuel consumption of the engines of 1936 and this, in conjunction with the application of laminar-flow techniques—with which experiments are now being carried out on United States airships—should enable higher speeds to be realized without appreciable increase in fuel consumption. It should also be possible to reduce engine, structure and fabric weights in the light of modern knowledge.

It is therefore virtually certain that a present-day successor to the *Hindenburg* would be able to carry a substantially increased payload; and this, in association with the increased working capacity derived from higher block speed, would be likely to render her a formidable rival to both the transport aeroplane and the ocean liner during the foreseeable future.

Southsea, Hants — F. P. U. CROKER
Lieut. Commander RN (Retd)

FORTHCOMING EVENTS

Mar. 11. RAeS: Symposium on Vehicle and Instrumentation Problems in Upper-atmosphere Research.
Mar. 12. Air-Britain: a.g.m., Annual Recognition Contest and Film Show.
Mar. 14. British Institution of Radio Engineers: Discussion on Short-range Navigational Aids.
Mar. 15. RAeS: "Some Problems of Separated and Vortex Flow," by Prof H. B. Squire.
Mar. 15. Photogrammetric Society: "A Recording Stereo Comparator," by A. H. Anstis.
Mar. 16. Aircraft Recognition Society: "Aircraft of the Future," by J. A. Hamilton.
Mar. 16. Royal United Service Institution: "Rockets, Satellites and Military Thinking," by Sir Frederick Brundrett.
Mar. 17. RAeS: "Supersonic Aircraft—Promise and Problems," by M. B. Morgan.
Mar. 18. RAeS Agricultural Aviation Group: Film Evening.
Mar. 18. Institute of Navigation: "The American Air Traffic Control Programme," by Dr Hans Giesecke.
Mar. 23. Royal Aero Club: a.g.m.
Mar. 24. RAeS: "Engines for Supersonic Airliners," by Dr R. R. Jamison.
Mar. 24. British Institution of Radio Engineers (Scottish Section): Radio Guidance in Automatic Landing," by J. Shayler (at Glasgow; repeated on Mar. 25 at Edinburgh).

RAeS Branch Fixtures (to Mar. 18): Mar. 15, *Glasgow*, "Lessons Learned from Aircraft Accidents," by J. G. M. Pardoe. Mar. 16, *Christchurch*, "Lighter-than-air Aircraft," by Lord Ventry; *Coventry*, "The Hovercraft," by G. H. Elsley; *Southampton*, Seventh Mitchell Memorial Lecture, by D. Keith-Lucas. Mar. 17, *Isle of Wight*, "Hovercraft," by C. S. Cockerell. Mar. 18, *Birmingham and Wolverhampton*, Branch President's Night.

CORRESPONDENCE IN BRIEF

Sqn Ldr P. G. Coulson writes from No 98 Sqn, RAF Driffield, East Yorks, to say that a 98 Squadron Association has been formed. Membership is open to all who have served in the squadron as officers and senior NCOs and the first reunion will be held in London on July 15. Further details may be obtained from the squadron CO at the above address.

THE INDUSTRY

Connecting the Crew-member

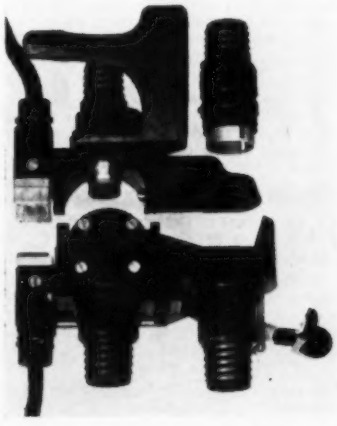
AN aircrew equipment connector has been developed by the Hymatic Engineering Co, of Redditch, Worcs, for crew-members in jet bombers who have to be able to move about within the aircraft. The connector forms a single junction between man and aircraft for intercom, visor and oxygen exhalation valve heating, oxygen supply and ventilated-suit tube, two aircraft portions being provided respectively for attachment to a fixed seat or position and to flexible leads for use during transit from one position to another. The development work was carried out in conjunction with RAE and the Institute of Aviation Medicine.

Just how complex are the requirements for such an apparently straightforward piece of equipment is emphasized by the detailed description below. This, incidentally, is the first occasion on which mention has been made of electrical heating for visor and oxygen expiratory valve.

The connector for the static seat position is known as the MSC3, while the transfer lead personal equipment connector is the MSC5. That all portions of the connectors be interchangeable is essential, as one half of the MSC3 is permanently attached to the crew member's flying suit. When the connections are broken all the gas connections carried both by the man and in the aircraft are automatically sealed. If the connector locking catches have not gone home, the two portions will spring apart and audible warning of the disconnection will be given by loss of intercom. Accidental disconnection of the connectors is impossible, state Hymatic, because of the gate movement of the manual release lever (attached to the aircraft portion of the MSC3) and the shrouding of the release lever of the MSC5; both levers have to be operated before the main portion can be disconnected.

The MSC3 consists of two sub-assemblies—the man portion (which is attached to the crew member's flying clothing) and the aircraft portion (which is attached to the seat, or to some other part of the aircraft structure). The man portion carries flexible anti-kink hose connections for the oxygen and ventilated-suit services and a group of butting contacts for intercom, visor and expiratory valve heating electrical services. The oxygen connection contains an inward breathing valve and a self-sealing valve. The former enables the crew member to breathe cabin air up to 8,000ft when not connected to the main oxygen supply. It allows breathing from the atmosphere if the emergency oxygen supply is exhausted during an emergency escape, and safeguards the man's life if he is still unconscious when his emergency oxygen supply is exhausted. The self-sealing valve prevents loss of pressure from the pressure suit (which is fed from the main emergency breathing oxygen supply when cabin pressurization has failed) during transfer from one crew position to another. Similarly, pressure is retained in the suit if the wearer abandons the aircraft at high altitude. [*Continued overleaf*

The Hymatic MSC3 personal-equipment connector described here



THE INDUSTRY . . .

The ventilated-suit connection on the man portion is rotatable and detachable, so that it can be passed through holes in the flying clothing, to allow the ventilated suit to be removed independently of the rest of the flying clothing. The suit connection must be properly made before a locking lever can be snapped home, and unless this lever is closed the man portion of the connection cannot be plugged into the aircraft portion. A spring-loaded self-sealing valve prevents water entering the suit should the man bale out into the sea.

Mounted on a backplate for bolting to the structure, the aircraft portion of the MSC3 carries an anti-kink hose connection and electrical contacts. The manual release lever operates in a gate and requires deliberate action and movement in two directions. The aircraft portion is so designed that the connection with the man portion must be complete before the services operate, and half-cocking is impossible. If the connection is not properly locked the man portion is automatically rejected by spring action. Both oxygen and ventilation connections contain low-pressure-drop, self-sealing valves to prevent wastage of oxygen and leakage of ventilation air during periods of disconnection.

The MSC5 transfer lead connects the intercom, visor and expiratory valve heating electrical services and the oxygen supply, but not the air for the ventilated suit, as this may be dispensed with for the short time taken in the transfer operation. It is a single unit to which the man portion of the MSC3 may be connected. The MSC5 carries an anti-kink hose connection for oxygen and electrical contacts for the aircraft side of the services, and has sufficient lengths of hose and electrical cable, strapped together, to permit free movement between the crew positions. When not in use the unit is stowed in a position accessible to the appropriate crew members who may be required to use it in transferring their positions.

Again, the MSC5 connector is so designed that if the connection is not properly made and locked the man portion is automatically rejected by a spring action. Release is by a scissors-type lever which requires the squeezing together of both sides, so that accidental release by knocking a lever is impossible.

Hinged to the top of the MSC5 connector is a spring-loaded dust cover to protect the oxygen connection, and a rubber flap extension protects the electrical services connection. The oxygen connection contains a self-sealing valve to prevent leakage when the man portion of the MSC3 is not connected.

Goodyear and the NA39

FROM the Goodyear Tyre & Rubber Co. (Great Britain) Ltd comes information that their wheels, brakes, tyres and anti-skid equipment have been specified for the Blackburn NA.39.

The "full circle" double-disc hydraulic brake, housed completely within the wheel, is unusual in that the non-revolving friction members slide axially on splines machined integrally with the axle. This arrangement, state Goodyear, gives a considerable saving in structural weight, and —together with the use of patent snap-in Goodyear linings— aids brake and wheel overhaul. The wheel incorporates a Goodyear development whereby the inboard flange is supported by a specially large diameter taper-roller bearing encompassing the brake housing and so avoiding the necessity for a heavily undercut wheel. Operation of the anti-skid system is by a wheel-driven sensing unit actuating solenoid valves through a transistorized control box. The hydraulic control system is designed and produced for use with Goodyear wheel and brake equipment by Electro-Hydraulics Ltd.

Tubeless tyres (35 × 10.00-17) are employed as original equipment on the production aircraft, and tyre fitting and removal are facilitated by the fact that the wheel is divided on the centre-line.

Meeting a Changing Demand

IN his report to shareholders at the H. M. Hobson Ltd a.g.m. on February 25 the chairman, T. Simpson, FRAeS, said that although changing conditions in the aircraft industry had caused a decrease in the company's trading profit it had been possible to maintain a higher level of production. Though numbers of military aircraft had been and were being reduced, the complexity of types under development demanded more of the special skills the company had acquired in design and manufacture of equipment. The market for civil aircraft continued to expand; and though in the immediate future there might be a temporary decrease in the demand for aircraft equipment, in the longer term the position ought to right itself.

Contracts had been obtained for Hobson equipment for a number of well-known civil aircraft at home and abroad, said Mr Simpson; and he also referred to the constant-speed alternator drive which the company is developing.

The group's consolidated net profit for the year ended September 30 last, after taxation, was £364,289 compared with £379,16 for the previous year.

Instrumental Collaboration

A NEW company, Drayton-Southern Ltd, is being formed by Southern Instruments Ltd and the Drayton Regulator & Instrument Co Ltd for the purpose of expanding the instrumentation and control interests of both companies, whose research, production and sales resources will be available to it. With an authorized capital of £100,000, Drayton-Southern will have the benefit of licensing agreements with American companies and initially will offer integrated monitoring and warning systems for industrial temperature, pressure, strain, vibration, acceleration, load and displacement measurement and control. The chairman will be Col P. H. Lloyd, TD, DL, and the managing director J. G. Lubbock.

IN BRIEF

It is announced that A. H. C. Greenwood, AFRAeS, MIAS, has been appointed an additional director of Vickers-Armstrongs (Aircraft) Ltd.

The R.F.D. Co Ltd has received a further order, worth £37,000, from Air France for inflatable liferafts and lifejackets for its new Boeing 707 fleet.

Bristol Siddeley engine exhibits at the Vienna Spring Fair (March 13-20) will include a sectioned Orpheus and Proteus, a Viper and a Gamma. Among their industrial products will be a model of the 3MW turbo-generator developed from the Proteus.

We regret to record that D. A. V. Rist, managing director of Rist's Wires & Cables Ltd, died on February 25. He had been in the motor and electrical industries since 1902, spent his early working life building up the company which bears his name, and had led it for many years.

The new Teleflex inertia-lock crew harness has been ordered by BEA for retrospective fitting to all their aircraft and is to be used in all crew positions in the D.H.121. The makers, Teleflex Products Ltd, of Basildon, Essex, state that this harness has been specified for practically all new British transport aircraft.

The current number (No 206) of the *Technical Notes* issued by CIBA (A.R.L.) Ltd of Duxford, Cambs, contains an informative and well-illustrated article on the production of aircraft research models by the use of Araldite glasscloth laminate. One of these models, used for spin testing by dropping from a balloon at about 3,000ft, was illustrated in *Flight* for October 16 last year.

In the centre of this console used in Armstrong Whitworth AW.650 flight testing is the ElectroniK strip recorder, supplied by Honeywell Controls Ltd. It gives a record of heat distribution in the engine zones, de-icing and air-conditioning systems, brakes, alternators and other components. In the AW.650, state Honeywell, it has been particularly valuable during development trials made in temperatures varying from arctic to equatorial

SERVICE AVIATION

Royal Air Forces and Naval Flying News

The Air Minister referred in the Air Estimates debate last week to fighters being adapted for flight refuelling. Here a Javelin FAW.7 is being refuelled by a Canberra of Flight Refuelling Ltd during recent trials. The cranked probe installation seen in use has since been modified

High-level Scrutiny

A VISITOR to Malta recently was the AOC-in-C Bomber Command, Air Marshal Sir Kenneth Cross. He flew out as co-pilot of a Valiant of No 90 Sqn (captained by the squadron commander, Wg Cdr F. S. Hazlewood) to see the AOC Malta, Air Marshal Sir Walter Cheshire, and to inspect Bomber Command squadrons on rotation training in the island.

Long Way Round

A VALIANT of No 214 Sqn remained airborne for 18hr 5min last week, covering 8,500 miles on a flight around the UK during which the crew made simulated bombing runs by radar and flew navigational exercise legs. The aircraft, captained by Sqn Ldr J. H. Garstin, was refuelled twice by a tanker Valiant of No 214 Sqn. An aircraft of this squadron flew the previous greatest distance by an RAF machine —6,140 miles to Cape Town last July in 11hr 28min.

Upwood Aeromedical Centre

A NEW RAF Aeromedical Training Centre has been formed at Upwood as a unit of No 1 Group, Bomber Command, and will give the kind of training offered to test pilots and other selected aircrew up to now by the RAF Institute of Aviation Medicine at Farnborough. Aircrew attending at Upwood (pilots, navigators and AEOs of the latest marks of Javelin and V-bomber and the Lightning) will undertake a five-day course of lectures and demonstrations of the most advanced equipment. The CO of the Centre is to be Sqn Ldr W. L. Aikman, a flying personnel medical officer, and on his staff will be three other MOs, two personal flying equipment officers and ten specialist airmen. Practical experience of the protection offered by partial pressure assemblies—masks, pressure helmets and jerkins, and anti-g suits—will be given in a decompression chamber reproducing all height conditions. Until the new centre is well under way, the Institute of Aviation Medicine will provide medical officers from its high altitude section to give advice when needed.

Puncturing Pomposity

THAT there is more than one way of looking at a university air squadron was clear from the Manchester UAS dinner on February 26. The Vice-Chancellor, Prof W. Mansfield Cooper, put the matter in the widest possible perspective. The air and the university, he said, were both places in which adventurous spirits could find a home. As he put it: "We belong to a great community and a great nation. In our university and in the air squadron you have the pride of forwarding its greatness." The chief RAF guest, Air Chief Marshal Sir Theodore McEvoy, put the squadrons on a more earthbound plane. All had one ability in common, the Air Secretary said, that of puncturing pomposity. A squadron was not regarded as a failure if only a few of its members entered the RAF; the link between the RAF and men who would occupy positions of importance was equally worth while. To the Manchester students he said: "We are extremely glad to have university people in the RAF, for they are the sort of people we want."

The third way of looking at a university squadron, from the CO's point of view, was exemplified by Sqn Ldr S. A. Harris. He said that Manchester UAS had done more flying hours than ever before (aided by "better weather than for 200 years past") and had managed to complete their flying task without trouble. Of 20 new members recruited this session, 16 had already gone solo.

Two presentations were made at the close of the dinner by AVM Colin Scragg, AOC No 23 Group, which controls the Northern squadrons. The Campbell Trophy for aerobatics went to Plt Off I. T. Nicol and the Cheshire Trophy (for the best all-round cadet) to Cdt Plt M. Baker.

In Brief

Sqn Off Lois K. Pitman has been appointed Director of the Women's Royal Australian Air Force.

A contract for the supply of a further quantity of Auster AOP.9s has been placed by the Ministry of Aviation with Auster Aircraft Ltd.

The Duke of Edinburgh is to visit RAF Wattisham on March 29 to present No 111 Sqn with the Britannia Trophy, awarded by the Royal Aero Club for "the most outstanding achievement" during the past year.

Units of 42 Commando, Royal Marines, are to embark in HMS *Bulwark* next Monday (March 14) prior to the carrier's departure for the Mediterranean that day. The embarkation is to include a fly-past by Whirlwinds of the carrier's No 848 Sqn.

Officers from the RAF Staff College at Bracknell are to lecture at the USAF Command and Staff College and at the RCAF Staff College during this month and in April. Led by the Commandant, AVM M. L. Heath, they are due to return on April 13.

The forty-third annual officers' reunion of No 46 Sqn, RFC and RAF, will be held at RAF Waterbeach on April 23. The traditional ladies' luncheon will be on the following day. Further particulars of both occasions will be gladly supplied by Sqn Ldr Peter Gifkins, Officers' Mess, RAF Linton-on-Ouse, York.

Three Britannias of RAF Transport Command are to provide a shuttle air lift between the UK and US for three days from June 10 to carry the 500 troops from all three Services taking part in the British Military Tournament and Tattoo being held at Madison Square Garden, New York, from June 17 to July 4.

Sqn Ldr G. C. Doak, CO of Edinburgh UAS (third from left), at the squadron's first dinner-dance which was held on February 22. On his left is Mrs Doak and on his right Cdt Plt S. W. Grierson and Miss Brodie

RN personnel preparing a KD2R-5 Drone at the Army range at Larkhill on Salisbury Plain. The Admiralty has procured a number from the Radioplane Division of Northrop for gunnery and SAGW practice

AIR COMMERCE

The House Debates the Bill

THOSE who have followed air transport affairs in Parliament in recent months will not have been surprised that the second reading of the Civil Aviation (Licensing) Bill on March 2 was not very searching. But at least the House devoted some considerable time to the subject—some five hours, which was more than was devoted to the Select Committee's report on BOAC and BEA (45 minutes), and infinitely longer than was devoted to the two corporations' annual reports, which have never been debated.

The Minister was obviously prepared for some criticism of the powers over the new board that he has reserved to himself. These were commented on in *Flight* for February 26, pages 261, 281, 283 and 291; and March 4, pages 315-316. This is what he said:—

"It is my intention that the board shall be as independent as it is possible to make it, for that is one of the primary purposes of the Bill. I have therefore kept down the Minister's powers to the minimum. The only important power which is reserved to the Minister is that of deciding appeals from decisions of the board. I think that it will be found that any other powers which are reserved for the Minister are very secondary in importance in comparison with the power to settle appeals."

This is a remarkable statement. The Minister says that his only important power is that of deciding appeals; yet he reserves the right to intervene on matters concerning international traffic rights [section 2(3)], and he reserves to himself complete control over international fares and also cabotage fares [section 2(5)(b)]. The airlines will have the right to appeal to the Minister against a decision of the board, certainly; but there will be no right of appeal to anyone if the Minister, by use of his *basic* powers, prevents an application from ever being considered by the board.

To say that his powers in respect of international rates and routes, and his powers under section 2(2)(g)—see (5) below—are "very secondary" (unnecessary hyperbole?) can only be regarded with astonishment.

It is important to record the Minister's comments on what he calls his "very secondary" powers. First of all, traffic rights:—

"I think that it will be agreed that it would not be right for an outside body such as a licensing board to put the Government under an obligation to open negotiations with foreign governments if they do not think it wise and opportune to do so."

And, on the subject of IATA fares:—

"It would be inappropriate, also not practicable, for the Government to delegate the control of fares to any other authority."

Both statements can be strongly contested, but neither was challenged during the subsequent debate.

The most important single piece of information which emerged was that the hearings of the new air transport licensing board will be in public. This public accountability, so lacking in the past, may do much to offset other weaknesses of the board. There is, however, a curious qualification: "It may, however," said the Minister, "be necessary to hold private sittings from time to time, for example if issues affecting international relations are being discussed." The number of times when an application will involve the discussion of international relations could, if the past is any guide to the future, be very large. Does this mean that the majority of the board's sittings will therefore be in private?

Other new points made by Mr Sandys or by his parliamentary secretary, Mr Rippon, or clarified by them, were as follows: (1) Application for licences will "in general" be advertised [at present they are *always* advertised in *Flight*, *The Aeroplane* and *The Times*]. (2) The board will not exercise any discretion in the matter of the award of "transitional" licences. These will be issued by the board "at the Minister's request" and in making that request:—

"It will be my intention to reproduce as nearly as possible the existing position. I shall have any necessary consultations with the corporations and independents to make sure that as far as possible everybody agrees that the instructions which I give to the board about transitional licences fairly reproduce the present position."

(3) The number of members to be appointed to the board [6-10] is "somewhat larger than in the case of the ATAC because it is intended that the new board shall be able to sit as and when necessary, in two divisions." The reason for this is evidently to ensure the most expeditious handling of applications. (4) Appeals against the Minister's decisions about the award of safety certificates (air operators' certificates) will be made to "an entirely independent arbiter."

(5) The controversial paragraph (g) of section 2(2), which gives the Minister the power to require the board to take into account when granting licences "any observations made by the Minister," will be published "where the observations are of a general character"; but on matters relating to international negotiations ". . . it will not be wise or possible to publish the Minister's observations."

* * *

The most cogent observations and criticisms made by members are picked out as follows:—

G. R. Strauss (Lab, Vauxhall) regarding the Bill as "so vague and unprecise that no one knows what its consequences will be." It was "ridiculous and indefensible" that the board could decide a matter of life or death on the strength of "a secret observation by the Minister." He hoped that when the bill was considered in committee one alteration would be that "any observation by the Minister" should be made public. If an independent wanted to run a service at a fare 10 per cent below those being charged by BOAC, was the fare aspect to be settled by the board or by the Minister? "If it is to be both it is ridiculous."

"Ten Air Transport Questions" on page 338, prepared by Harold Caplan, compare the present and proposed UK air transport regulating systems with those of the US and Canada.

John Rankin (Lab, Glasgow, Govan) had evidently taken note of this journal's commentary on the bill (*Flight*, February 26, page 283). He observed that the board would not have "any policy-making powers about international agreements and fares," the person in control of which would be the Minister. However, he would not seriously object to this because it would "bring Parliament more closely into association with this work." Again, Mr Rankin thought it "remarkable" that there was no reference to the public interest nor for the need for the board to "consider in particular" the expansion and promotion of British air transport. He thought that the last named should be regarded as a chief function of the board. Again, he said that "no definite purpose" was assigned to the board, and he suggested that one purpose should be that it should "collect statistics of finance, traffic, profits and losses. . . ." And he regarded the presence of the Press at meetings of the board as a desirable form of public accountability.

George Chetwynd (Lab, Stockton-on-Tees) wanted "much more information about the Government's intentions." There was "no provision whatsoever for public knowledge of what the Minister's observations to the board would be," and—more echoes from these pages on February 26—there was no power under the Bill for the board to call upon the airlines for full financial and traffic statistics. No one knew the financial state of the independents or how much traffic they carried—there was a "woeful lack" of information. There was no provision, apart from what the Minister had said orally, for public hearings; and "what is more important, there is no regard for the [public]."

The Bill will now pass through the committee stage before the third reading.

J.M.R.

Footnote: Three speakers in the debate made reference to Frank Beswick's interview with Harold Bamberg, chairman of Eagle, in *Flight* of February 26. Mr Beswick's comments on the debate will appear next week.

SWANSEA'S "SHANTYTOWN"

CAPITAL expenditure on Swansea Airport has totalled £40,285 since the Swansea Corporation took it over in 1955. Income in the same period was only £331. This was said by the chairman of the Swansea Parliamentary Committee, Percy Morris, in a recent reply to a comment from the secretary of the Swansea Chamber of Commerce, A. G. Bishop, who had said that the Corporation had not spent on the airport "a tenth of the money" it should have spent.

Capt Adrian Ross, director of Trans-European Airways (the only company running a charter service from the airport) has said that his company had lost about £5,000 in the seven months it had been operating from the airport. He said that lack of public support, caused by ignorance of the fact that the airport was available for public service, had contributed to the loss. "A great deal must be done to clear the airport of its derelict buildings and rid it of its shantytown appearance," Capt Ross said.

FIRST DORNIER 28 ORDER?

A SYSTEM of feeder services to link South Africa's main centres with rural towns is planned by the independent airline Protea Airways. The company has applied to the National Transport Commission for a licence for 18 different routes in each of the Union's four provinces. These services would connect country areas with Germiston, Durban, Port Elizabeth, East London, Capetown, Queenstown and Bloemfontein.

Protea, which already has a licence to operate unscheduled flights throughout Africa and to various points in Asia Minor, is shortly to begin regular Viking services between Johannesburg and Cairo. It plans to use five twin-engined Dornier Do28s on the internal flights, most of which would operate twice weekly. This is the first news of an impending order for the Do28, production of which is expected to start this summer. A prototype was demonstrated at the Paris Show; it seats five, is powered by two 180 h.p. Lycoming O-360s and has a range of about 800 miles.

Protea Airways is an associate company of another South African independent, Trek Airways. The chairman is H. J. Martins, MP for Wakkerstroom.

AVRO's SHORT-HAUL JETS

IT is understood that A. V. Roe have for some time been examining a small short-haul jet airliner and that studies have been crystallized into two specific projects powered by divided-flow gas turbines. Market studies are now being conducted. The two projects are: (1) a 50-seater based on two Bristol Siddeley BS.75 engines of 7,000lb thrust, and (2) a machine of 65 seats using two Rolls-Royce RB.163s (10,100lb thrust). Both aircraft would cruise at high subsonic speeds and carry their full payload over stage lengths of 500 n.m. with full fuel reserves. In each case the engines would be mounted on the rear fuselage *à la* Caravelle or Hunting H.107 (48-56 seats), to which they might thus be expected to bear a superficial resemblance.

Avro are said to regard the short-haul aircraft as an important member of the jet transport family and to consider that the "little jet" would not overlap the Avro 748 market. With the absorption of de Havilland into Hawker Siddeley Aviation, A. V. Roe would clearly be able to draw on D.H.121 aerodynamic and design experience where it was applicable to the smaller aircraft.

Are these two projects to be classified as "Viscount-replacements," notwithstanding a similar definition of the much larger (100-seat) D.H.121? The answer lies in the meaning of the word "replacement." If by this it is meant the aircraft which will take over from developed versions of the Viscount as these become obsolete, the D.H.121 is closer in definition than the Avro projects, because it represents a later stage of evolution of the short-haul airliner and is thus of that much greater capacity than the Viscount. But if as a definition it is accepted that a replacement is of a size to do the task for which its predecessor was designed, though at a later period, the Avro short-haul jets can also reasonably be classified as replacements for the Viscount. This digression is made in an attempt to explain some of the contradictions that have been with us ever since the phrase "DC-3 replacement" was first used 15 years ago.

For Avro to undertake project studies into two short-haul jets on top of other work in hand and in addition to acting—as has recently been announced—as team leader for the Hawker Siddeley Group's supersonic airliner studies, gives them an extraordinary number of major tasks to fulfil. With the first Avro 748 to be rolled out within three weeks and to fly before the end of April much work must clearly lie ahead with this programme. Of the Avro 748, Sir Roy Dobson, managing director and vice-chairman of the Hawker Siddeley Group, has said: "There must not be a single fault in the aeroplane. It must be perfect first time."

It can now also be stated that Avro are to submit to the Government plans for VTOL and STOL aircraft. It may be supposed that such machines would be in competition with the very advanced Bristol designs discussed in Dr Hooker's paper, reviewed in *Flight* of January 1 last.

Finnair's first Caravelle was christened "Blue Bird" at the handing-over ceremony at Toulouse on February 21 when it was received by the president of Finnair, Gen Leonard Grandell. The second aircraft is to be delivered this month and services will start on April 1

MUNICIPAL AIRPORTS: A NATIONAL ASSET

IN a memorandum on British airports, recently sent to the Ministry of Aviation, the Association of British Chambers of Commerce recommends extensive Government financial assistance. In October 1959, runs the preamble, there were 160 aerodromes available to civil aircraft in the British Isles. Of these 26 were owned or controlled by the Ministry; 54 were licensed for joint use with prior permission required from civil aircraft; 25, including municipal airports operated by local authorities, were licensed for public use; 18 had no licence; and 37 were licensed for private use. At 21 of the 160 Customs facilities were available.

All Ministry-owned airports (see "UK Airports in the Red," *Flight*, February 26) operated at a loss. (Some municipal airports, including Manchester and Southend on the other hand, made a small profit.) The Association proposes that urgent consideration should be given to developing and selecting a number of airports, including new ones, where there is both a passenger and/or freight potential. Those chosen to form the basic national network, it is suggested, should not limit the total number.

The recommendations go on to remark that though few airports can be expected to operate without loss over the next few years their provision should be regarded as a public amenity. Part of the cost should, if possible, be borne by a local authority. But for airports to be capable of useful operation, say the Chambers of Commerce, they must be adequately equipped, and the Minister is being urged to provide grants on a diminishing scale (for a limited period of, say, ten years) to assist municipalities to develop facilities while the traffic is growing. They should also be given access to capital by way of grants or loans.

Air traffic control for airports within the national network and for other airports operated by municipalities should be provided by the State; so should technical services and equipment and Customs facilities.

Finally, the Association again puts forward the idea that all fuel used by aircraft on internal services should be subject to a rebate of duty "to preserve equality of cost between operators of internal services and those operating international routes."

STARWAYS TO GLASGOW

A BRIEF announcement from the Ministry of Aviation last week gave approval to the recommendations of the Air Transport Advisory Council that Starways should be granted a licence to operate a scheduled DC-3 service between Liverpool, Speke, and Glasgow, Renfrew. Approval is limited to the period between June 3, 1960, and April 1961.

At first sight this licence appears to give Starways a share of the sector traffic on BEA's monopoly service between London and Glasgow. But the terms permitted by the ATAC are such that the independent airline is effectively prevented from offering a one-stop service on this route. The schedule approved is for Renfrew flights to depart from Speke at 1600hr each Friday and arrive at Glasgow at 1715, while the six-times-weekly return service from London does not reach Liverpool until 1800hr the same evening.

Nevertheless the new operation is a milestone in Starways' history as it is only the second domestic scheduled service to be granted since approval to operate from Liverpool to London was given in April 1955. This service has since been operated continuously at a capacity of 432 seats a week. A feature of Starways' operations is their very low revenue rate—5.1 pence per statute mile on the 165-mile sector between London and Liverpool. This is slightly lower than the rate per mile charged by BEA for a tourist single fare on the 342 miles between London and Glasgow. The Starways' fare between Speke and Renfrew will be £3 18s, corresponding to the very low (relative to other UK fares) revenue rate of just over 4¼d per statute mile.

The new service will operate on a semi-experimental basis, with capacity provided according to traffic demand throughout the summer, but will probably cease for the winter on September 23. If the venture proves successful Starways will need to apply to the Air Transport Board for a renewed licence from April 1961.

Variation on a now familiar scene is provided by this Varig Boeing 707-441 (Rolls-Royce Conways) after roll-out at Renton. About $6.9m (£2½m) is being lent to Varig by the Ex-Im bank to finance their order for two. The aircraft will be based at New York and maintained by Lockheed Aircraft Services International

AIR COMMERCE . . .

THE BIG INDEPENDENT MERGER

HOW big relative to the two corporations is the new Airwork Hunting-Clan consortium? Since full financial and traffic statistics for each airline are secret (traffic on scheduled services only is known), a comparison in terms of traffic carried cannot be made. But it is possible to make a rough comparison in respect of existing ton-m.p.h. fleet capacity; and in these terms the new group is about 28 per cent the size of BOAC and about 44 per cent the size of BEA (see below).

Very few details of the merger, which was announced on March 1, have been released. The brief statement published by the two independents read as follows:—

"Mr M. D. N. Wyatt, chairman of Airwork Limited, Mr P. Ll. Hunting, chairman of Hunting-Clan Air Transport Limited, and Sir Nicholas Cayzer, chairman of the British and Commonwealth Shipping Group, announce that it has been decided to merge their air transport interests.

"Further details of the merger will be announced at a later date."

Airwork is the bigger operator—in the ratio of 3:2 in terms of fleet capacity. No reference is made in the statement to the shipping interests in the Airwork Group—Blue Star and Furness Withy, who own about a third each. (The other main shareholder in Airwork is Whitehall Securities.)

British & Commonwealth Shipping, who are mentioned (their name appears on the two HCA-operated Britannias), own 50 per cent of Hunting-Clan Air Transport, and the Hunting Group shipping concern owns the other 50 per cent. The name Clan signifies the interest of the Clan Line shipping concern before it merged with Union Castle to form British & Commonwealth Shipping early in 1956.

It is highly probable that the new group will be given a name. This will almost certainly be prefixed by the word "British". It is not known whether the name "United Airways," registered in 1935 by Airwork, will be included: it is believed to be under consideration.

In due course it may become clear what inducement the Minister offered the two companies to encourage this merger, which is the first fruit of his stated policy to create bigger and stronger groups in the independent airline industry. His first public reference to this policy was at the BIATA dinner last November. It is significant that Airwork and Hunting-Clan have been in partnership on the colonial coach "Safari" routes to East Africa since June 1952, to Central Africa since July 1953, and to West Africa since June 1954. An article on HCA's contribution appeared in *Flight* for January 22; and the controversy over the future of these colonial coach services—which both companies applied a year ago to operate at "VLF" rates—was aired in the issues of January 1 and January 8. It is likely that economy class services will be introduced on the East and Central African routes this year, either by BOAC on a cabotage basis or as part of a new international fare structure. Whether a 30-70 division of these services (as proposed by the Government in 1957), or perhaps a more equitable share has been offered to a merged Airwork/HCA consortium must remain for the present a matter for speculation. ("Straight and Level," February 26, p. 281.)

Only the air transport interests of the two companies are involved in the merger. HCA have an interest in Hunting-Clan Air Carriers, which was formed last January following the disbandment of Hunting-Clan African Airways. The associated HCA company, Field Aircraft Services, is not included.

Airwork own Air Charter, Transair, Morton/Olley Air Services; and their big helicopter interests—to which were recently added Bristow Helicopters—are included in the merger. The fleets are as follows:—

Airwork Group

Aircraft*	Number	Capacity Ton-miles per hour (approx.)
Britannia 307	2	7,500
Viscount 831	2	4,500
Viscount 804	3	6,000
Viscount 736	2	2,800
DC-4	3	2,700
Bristol Freighter	9	8,400
DC-3	3	1,500
Heron	2	450
Dove	7	1,000
Rapide	3	150

*Helicopters (50) omitted. Total: 35,000

Hunting-Clan

Aircraft	Number	Capacity Ton-miles per hour (approx.)
Britannia 317	2	7,500
DC-6C	2	5,750
Viscount 833	3	6,750
Viking	5	3,000
DC-3	3	1,500

Total: 24,500

Thus the total fleet capacity (ton-miles per hour) of the new group is roughly 60,000. This compares (rough estimates again) with 214,000 ton-miles per hour for BOAC and 137,000 ton-miles per hour for BEA. Thus British United Airways—or whatever name is chosen—has a fleet capacity of about 28 per cent relative to BOAC, and about 44 per cent relative to BEA.*

These relative sizes will fall steadily during 1960 as BOAC take delivery of 15 Boeing 707-420s and as BEA take delivery of 20 Vanguards. The relative fleet capacities will become about 19 per cent and 29 per cent respectively.

***BOAC:** 15 Britannia 102 (50,000 ton-m.p.h.); 17 Britannia 312 (63,000); 10 DC-7C (33,000); 19 Comet 4 (68,000)—total: 214,000 ton-m.p.h.

BEA: 6 Comet 4B (22,600); 21 Viscount 802 (31,400); 18 Viscount 806 (27,000); 24 Viscount 701 (33,400); 44 DC-3 (22,000); 2 Heron (450); 3 Rapide (150)—total: 137,000 ton-m.p.h.

SUPERSONIC PARIS NORD

NOW under consideration in France is a report by the director-general of the Paris airports into the possibilities of establishing a new airport to the north—Paris Nord. Because of the limitations of built-up areas to the south, hilly country to the west and north-west, and the direction of prevailing winds to the east, it has been concluded that the only possible area lies to the north-east of Le Bourget between Route Nationale 17 in the west and the valley of the Biberonne River in the east.

Nevertheless the disadvantages of this site are said to be serious and the Paris airport authorities (i.e. of all airports in the Paris area) are not particularly enthusiastic about the plan. In any case it would cost at least as much (500m new francs) to implement as the cost to date of Le Bourget and would also involve the absorption of 2,500 hectares of cultivated but boggy land. But from a study of forecasts into the anticipated increase of passenger movements at Paris it seems that there may be no alternative. It has been predicted that there will be 210,000 aircraft movements a year at Paris by 1974, and 220,000 in about 1980. By then the Paris Nord airport could be expected to handle 50 per cent of the total traffic—6,000,000 passengers a year at a peak of 3,300 in any one day.

Paris is the first airport authority in the world to face up to the problems of designing for supersonic aircraft. From an airport point of view, practically nothing about these aircraft is known. What, for example, will be the length of runway required? Practically zero, or longer than ever before?

The plan for the Paris Nord airport is to provide 13,000ft supersonic aircraft runways that could be extended to 16,500ft.

They would be placed end to end in line with the prevailing wind but set 10,000ft apart. It is also proposed that a single shorter runway placed at 90° to the two main runways should be provided to cover occasional wind changes.

If it did transpire that supersonic aircraft were produced with VTOL capacity the airport could presumably be easily contracted. Perhaps the best example of the doubts that are raised in the minds of the airport planners is that those studying Paris-Nord have provided for eight vertical take-off platforms.

AIR UNION BY NOVEMBER

CONFIRMATION that the inauguration of Air Union is to be postponed until November—as forecast in *Flight* for January 15—was given last month at the close of a meeting of the French, German, Italian and Belgian foreign ministers in Paris. The first step towards full union is to make tickets transferable and to co-ordinate the schedules and administration of the four Air Union airlines. But technical and legal complications which have arisen have caused the original date of inauguration—April 1—to be postponed.

The revenue-sharing scheme which was to come into operation when traffic had increased five-fold is now reportedly being disputed by Alitalia and Lufthansa. Both airlines feel that their quotas should be increased, as their recent rates of growth have exceeded expectations. Another matter now again concerning Union negotiations is the scheme under which Sabena's Congo domestic services were to be detached from the Union although included within its broad framework.

Standardization of equipment raises another problem. Three of the carriers—Air France, Alitalia and Sabena—are Caravelle purchasers; but Lufthansa, as the single exception within the Air Union four, apparently shows no inclination to purchase the aircraft which France would dearly like to see generally adopted.

Previous *Flight* references to Air Union, for the record, are as follows: **1959:** February 27, March 6, April 10, May 1, May 8, May 29, June 5, June 12, June 19, September 11, September 25, November 6, November 13. **1960:** January 15. These trace Air Union history from the germ of the idea up to the prospect of realization later this year.

CHEAP FARES FROM AFRICA

SOUTH AFRICAN AIRWAYS, who are hoping to get some of the cheap-fare traffic between South Africa and Britain, are negotiating to provide the closed-group Overseas Visitors Club with a Skymaster service twice a month. When the airline takes delivery of its Boeing 707 fleet the service would be operated with DC-7Bs. The club, whose fare is about half that of the scheduled airlines' tourist fare, was twice opposed by South African Airways when it sought—unsuccessfully—to get a licence from the National Transport Commission to operate into Jan Smuts Airport.

The club responded by operating into Lourenço Marques and including a rail ticket from there to Johannesburg in the one-way off-season fare of £67 10s and the in-season fare of £95. This makes it possible to get a Johannesburg - London return ticket for £135 compared with the tourist return fare of £273 12s. The service is operated with Argonauts by Overseas Aviation. This company has an associate, Trans-Africa Air Coach, which also operates at similar fares between Luxembourg and Lourenço Marques, while Starways of Liverpool have been operating from London to Lourenço Marques on a cheap-fare basis for the Travellers Facilities Club, a "rival" of the Overseas Visitors Club. The latter already has authority to operate from London to Canada at fares about half that of the scheduled airlines and has operated a number of charter flights from London to Australia.

SAA's negotiations have caused consternation in the South African travel world and the Association of South African Travel Agents has formally protested. A deputation from the association is also believed to have indicated to the Railways Administration that it will book passengers on other airlines if SAA continues to flirt with the Overseas Visitors Club. The association says it welcomes lower fares but that they must be available to all passengers, not just to club members. It costs £3 3s to join the Overseas Visitors Club and £1 1s a year subscription.

The Railways Administration has since issued a statement stating that it does not intend breaking any IATA rules and that in the past it has refused to hire aircraft to the club. But it adds that conditions have now changed and that it no longer considers it against IATA rules to offer cheap terms to the club. This development follows upon SAA's decision to "go it alone" on economy fares for Africa if IATA does not reach agreement at its meeting in Paris on February 23.

Stop press: It has just been announced that the 35,000-member Overseas Visitors Club has signed a £250,000 contract with SAA to operate 30 closed-group charters a year between Johannesburg and London at the return fare of £135. Constellations and DC-4s will be used and the only stops will be for refuelling. The contract is expected to be worth about twice as much next year as a result of rapidly increasing membership of the club.

THE MASKED PILOT

ALTHOUGH it has now been deferred for 60 days for further investigation, a rule which the Federal Aviation Agency brought into effect on February 1 requires that one pilot in control of a turbine-powered aircraft must wear an oxygen mask when flying higher than 30,000ft. A subsidiary rule is that other members of the flight crew who are on duty must wear—although not necessarily use as breathing apparatus—oxygen masks which can be quickly donned. The definition of a mask which can be "quickly donned" is given as one which can without delay be placed on the face and properly secured and sealed with one hand without disturbing headphones, glasses or caps.

It is the FAA's intention to re-inspect every mask that is claimed to have these features; where a design is not satisfactory it will be necessary for one pilot at the controls to wear a mask when the aircraft in which he is flying is above 25,000ft. This latter rule may be relaxed when investigations into the safety aspects at altitude are completed.

An interesting point about this new rule is that it applies not only to all US domestic operations but to US international operations as well; PanAm or TWA 707 pilots operating into London for example, may thus have been on oxygen for the majority of an eight-and-a-half-hour transatlantic flight.

Footnote: BOAC and BEA have similar rules for the use of oxygen masks. For BOAC these are: (1) If cabin altitude rises above 10,000ft (an exceptional circumstance) all the crew must be on oxygen; (2) If the aircraft is below 30,000ft, masks need only be properly stowed ready for use; (3) Between 30,000 and 40,000ft one pilot at the controls must have a mask attached to his headset ready for donning; (4) Above 40,000ft one pilot at the controls must always use oxygen.

BEA's Comet 4Bs are equipped with drop-out oxygen masks at each crew station; three overhead and one at the side. At present it is necessary to release them manually when audible warning is given that cabin pressure has fallen below the equivalent of that at 10,000ft, but the system is being modified to operate automatically. Because cruising altitudes rarely exceed 35,000ft, no special regulations are in force about one pilot breathing oxygen or having a mask near his face ready to don.

The units shown on the left are part of the automatic reservations system in use by SAS. The system cost about £350,000 and can handle a million messages per month

The new BEA colour scheme of red, white and black has been applied to the helicopter fleet. Of the two Whirlwinds shown at Gatwick, the nearer is that used in instrument flight-development

AIR COMMERCE . . .

BEA'S BUS SERVICE

ON his return from a three-week sales and promotional tour of South and Central Africa, Anthony Milward, chief executive of BEA, said that on domestic trunk routes next spring he hoped to see a pilot scheme in operation whereby passengers would be able to buy a ticket at the airport and board the first available aircraft. Mr Milward said that he thought it would be some time before a similar facility could be offered on international services. The chief saving was in paperwork.

This scheme requires a high frequency of flights and BEA have recently announced that from April 1 services between Manchester and London are to be increased from four to eight flights a day —a doubling-up of schedules for which there has been considerable pressure by Manchester businessmen. An application by Eagle to operate fixed-wing and helicopter services over the same route was recently made to the ATAC. This is their second application, the first having been rejected in 1957.

DON BENNETT AND THE PRINCESSES

OVER the past eighteen months there has been considerable speculation concerning the possible purchase by AVM Donald Bennett of the Saunders-Roe Princess flying-boats and the placing of these machines in commercial service.

AVM Bennett told *Flight* earlier this week that he has been unable to obtain any firm decision from the Government and has therefore been forced to give up the idea. He still deplores the fact that these aircraft should not be utilized, particularly as they would be "a wonderful proposition" with Rolls-Royce Tynes.

EXTENSIONS AT SCOTTISH AIRPORTS

WHILE the fate of Renfrew as the airport for Glasgow is still in the balance (see *Flight*, February 19), extensions are being made both at Prestwick and at Edinburgh Turnhouse.

At Prestwick extension of the main runway to 9,800ft is well advanced and it should be available for use by June. As a second stage in the airport's £3m redevelopment scheme, work is shortly to start on a new control tower.

At Edinburgh extensions are being made to the apron, which is now to provide stands for five aircraft of a size equivalent to, say, two Vanguards and three Viscounts. Previously the capacity was sufficient only for three Viscounts and one smaller aircraft.

BRITANNIA PAYLOAD

AN increase of about 4,000lb in the payload which can be lifted by BOAC's Britannia 312s has been obtained by a recalculation of the safety speed, V_2. When the aircraft was first certificated it had been calculated that V_2 should be established as $1.19V_s$ (where V_s is the stalling speed). After further tests it has been found that V_2 can safely be reduced to the minimum specified in BCARs—$1.15 \times$ stalling speed. Rotation and unstick is thus performed sooner, and either payload can be increased or, with the payload unchanged, less runway will be used.

SEPARATE MORE CLOSELY

A NEW study into altimetry and vertical separation recently issued by IATA recommends that by 1965 1,000ft vertical separation should be extended up to 50,000ft. At present limits are 23,000ft in the US and 29,000ft in Europe.

Methods of achieving separations of this order are, IATA suggests, by the use of precision pressure altimeters with or without servo correction and by altimeters with better performance. For aircraft equipped with common pressure altimeters, the Association consider that the 1,000ft vertical separation standard is acceptable up to 29,000ft. Separation intervals of less than 1,000ft should be the aim and the IATA report recommends that investigations into ways of achieving this be continued. One method is the flight level indicator based on constant pressure intervals.

FRANCO-AUSTRALIAN ENTENTE

"A HIGHLY satisfactory negotiation" is the Australian comment on the conclusion of the meeting in Paris on February 24 and 25 between Senator Paltridge, Australian Minister for Civil Aviation, and Robert Buron, French Minister for Public Works and Transport, to conclude a permanent air agreement between Australia and France. Last December, as a result of a disagreement, TAI's "beyond" rights in Australia were abruptly cancelled. So were Qantas' rights in New Caledonia.

As a result of the recent renegotiations TAI is to be given "beyond" rights out of Sydney on a round-the-world route from Paris linking with Air France at Los Angeles. Qantas is to be given a route from Australia through India to Paris or through Marseilles to London, a route through New Caledonia and the New Hebrides to New Guinea, and a route through Tahiti to London. Australia and France may later both operate services between Australia and South America via Tahiti.

SHANNON NOT READY FOR JETS

REPLYING to questions in the Dail last month, the Irish Minister for Transport and Power said that it was anticipated that the new jet runway at Shannon Airport would be completed and ready for use not later than the contract date, August 2, 1960. All possible action, including the operation of shift working, was being taken to have the runway completed as soon as possible.

The Minister's reply means that the number of movements through Shannon will be considerably reduced during the summer peak period this year. The international carriers who operate increased frequencies on the north Atlantic route via Shannon during the summer will be compelled to limit the number of services landing there during 1960 due to operational restrictions on the use of their new jet equipment. It appears, therefore, that all scheduled flights through Shannon will be operated with turboprop and piston-engined aircraft, though technical stops of jet aircraft (not exceeding an all-up weight of 210,000lb) will continue to be made using the present runways.

At the end of February, Sabena closed down their Flight Dispatch Unit at Shannon as an economy measure—coincident with introduction of their Boeings on the North Atlantic.

BREVITIES

Asked to comment on reports last week that BEA may operate the Argosy, a corporation spokesman said: "We are actively studying the possibility of using Argosies on our freight services." *Flight* understands that three might be leased from Hawker Siddeley for operation in 1961.

Construction of Nicosia's new terminal airport, costing some £500,000, is to start shortly.

Following a visit by a Spanish tourist promotion team to South Africa, traffic rights at Madrid may be granted to PanAm on its New York - Johannesburg services.

A Fokker Friendship is at present being demonstrated in South Africa. It is to visit Johannesburg, Cape Town, Port Elizabeth, East London and Lourenço Marques.

The two Boeing 707-120s ordered by Cubana for delivery in March 1960, and which have been cancelled, are to be leased from Boeing by Western Air Lines, who have also purchased three Boeing 720s.

The Dart Herald is among the aircraft specified by East Anglian Flying Services in their application to the ATAC announced today, March 11, for scheduled services from Portsmouth and/or Shoreham to Cherbourg, Dinard, La Baule, Le Havre and Deauville.

Uxbridge Civil AIS Area Centre is to be closed on March 27. The functions of the unit will be taken over by London Airport AIS Centre and the combined centre is to be known as Southern AIS Centre, London Airport. Reference to it is made in the MoA *Civil Aviation Information Circular* 19/1960.

Following reports of Folkestone Corporation's interest in cross-Channel hovercraft services, Blackpool Corporation have been holding discussions with the National Research Development Corporation. The corporation are considering the possibility of a hovercraft service between Blackpool and Southport, Liverpool, Barrow and Morecambe within the next five years.

Ozark may increase its F-27 fleet from three to five this summer, according to the airline's president, Joseph H. FitzGerald.

There were no injuries among passengers or crew when the port main undercarriage leg of a BKS Elizabethan collapsed after a landing at Newcastle Airport on March 3.

Frank Collier, BOAC's assistant manager London station, has been appointed manager at London Airport. He succeeds C. H. Bizzell, who is retiring.

The Ukraine, Crimea, Caucasus, Siberia and Central Asia are all areas in which helicopter routes are to be opened in the Soviet Union. There are to be over 200 according to reports from Moscow.

Pakistan International Airlines became the first Asian airline to operate a jet service last Monday, when their once-weekly service was inaugurated between London and Karachi (see *Flight*, February 19, 1960).

A three-year programme to develop Yeadon Airport has been approved by the Leeds Bradford Joint Airport Committee. The plan includes a two-storey terminal with an observation enclosure and is expected to cost £400,000.

Noise tests conducted at London Airport to determine the suitability of BEA's Comet 4B for 2300hr to 0700hr "sleeping hour" take-offs and arrivals were suspended last week by "technical trouble" after two tests had been carried out.

Sheik Najib Alamuddin, chairman of MEA, was reported to have said in London last week about his £6m order for four Comets: "If the deal is not authorized by Tuesday night [March 8] my board will have to start looking at other aircraft, French or American." The delay is said to have been caused by Treasury failure so far to agree to BOAC's guarantee of the purchase from de Havilland.